H.R. 3245, COMMERCIAL SPACE ACT OF 2003

HEARING

BEFORE THE

SUBCOMMITTEE ON SPACE AND AERONAUTICS

COMMITTEE ON SCIENCE

HOUSE OF REPRESENTATIVES

ONE HUNDRED EIGHTH CONGRESS

FIRST SESSION

NOVEMBER 5, 2003

Serial No. 108–33

Printed for the use of the Committee on Science

Available via the World Wide Web: http://www.house.gov/science

U.S. GOVERNMENT PRINTING OFFICE

90–164PS WASHINGTON : 2004

For sale by the Superintendent of Documents, U.S. Government Printing Office
Internet: bookstore.gpo.gov Phone: toll free (866) 512–1800; DC area (202) 512–1800
Fax: (202) 512–2250 Mail: Stop SSOP, Washington, DC 20402–0001

COMMITTEE ON SCIENCE

HON. SHERWOOD L. BOEHLERT, New York, *Chairman*

LAMAR S. SMITH, Texas
CURT WELDON, Pennsylvania
DANA ROHRABACHER, California
JOE BARTON, Texas
KEN CALVERT, California
NICK SMITH, Michigan
ROSCOE G. BARTLETT, Maryland
VERNON J. EHLERS, Michigan
GIL GUTKNECHT, Minnesota
GEORGE R. NETHERCUTT, JR., Washington
FRANK D. LUCAS, Oklahoma
JUDY BIGGERT, Illinois
WAYNE T. GILCHREST, Maryland
W. TODD AKIN, Missouri
TIMOTHY V. JOHNSON, Illinois
MELISSA A. HART, Pennsylvania
JOHN SULLIVAN, Oklahoma
J. RANDY FORBES, Virginia
PHIL GINGREY, Georgia
ROB BISHOP, Utah
MICHAEL C. BURGESS, Texas
JO BONNER, Alabama
TOM FEENEY, Florida
RANDY NEUGEBAUER, Texas

RALPH M. HALL, Texas
BART GORDON, Tennessee
JERRY F. COSTELLO, Illinois
EDDIE BERNICE JOHNSON, Texas
LYNN C. WOOLSEY, California
NICK LAMPSON, Texas
JOHN B. LARSON, Connecticut
MARK UDALL, Colorado
DAVID WU, Oregon
MICHAEL M. HONDA, California
CHRIS BELL, Texas
BRAD MILLER, North Carolina
LINCOLN DAVIS, Tennessee
SHEILA JACKSON LEE, Texas
ZOE LOFGREN, California
BRAD SHERMAN, California
BRIAN BAIRD, Washington
DENNIS MOORE, Kansas
ANTHONY D. WEINER, New York
JIM MATHESON, Utah
DENNIS A. CARDOZA, California
VACANCY

SUBCOMMITTEE ON SPACE AND AERONAUTICS

DANA ROHRABACHER, California, *Chairman*

LAMAR S. SMITH, Texas
CURT WELDON, Pennsylvania
JOE BARTON, Texas
KEN CALVERT, California
ROSCOE G. BARTLETT, Maryland
GEORGE R. NETHERCUTT, JR., Washington
FRANK D. LUCAS, Oklahoma
JOHN SULLIVAN, Oklahoma
J. RANDY FORBES, Virginia
ROB BISHOP, Utah
MICHAEL BURGESS, Texas
JO BONNER, Alabama
TOM FEENEY, Florida
SHERWOOD L. BOEHLERT, New York

BART GORDON, Tennessee
JOHN B. LARSON, Connecticut
CHRIS BELL, Texas
NICK LAMPSON, Texas
MARK UDALL, Colorado
DAVID WU, Oregon
EDDIE BERNICE JOHNSON, Texas
SHEILA JACKSON LEE, Texas
BRAD SHERMAN, California
DENNIS MOORE, Kansas
ANTHONY D. WEINER, New York
VACANCY
RALPH M. HALL, Texas

BILL ADKINS *Subcommittee Staff Director*
ED FEDDEMAN *Professional Staff Member*
RUBEN VAN MITCHELL *Professional Staff Member*
KEN MONROE *Professional Staff Member*
CHRIS SHANK *Professional Staff Member*
RICHARD OBERMANN *Democratic Professional Staff Member*
TOM HAMMOND *Staff Assistant*

CONTENTS

November 5, 2003

	Page
Witness List	2
Hearing Charter	3

Opening Statements

Statement by Representative Dana L. Rohrabacher, Chairman, Subcommittee on Space and Aeronautics, Committee on Science, U.S. House of Representatives	6
Written Statement	7
Statement by Representative Bart Gordon, Minority Ranking Member, Subcommittee on Space and Aeronautics, Committee on Science, U.S. House of Representatives	7

Witnesses:

Mr. Gary C. Hudson, Chief Executive Officer, HMX, Inc.	
Oral Statement	8
Written Statement	10
Biography	13
Mr. Michael S. Kelly, Technical Manager, Northrop-Grumman/Xon Tech	
Oral Statement	14
Written Statement	17
Biography	20
Mr. Raymond F. Duffy, Jr., Senior Vice President, Willis InSpace Insurance Underwriters	
Oral Statement	22
Written Statement	24
Dr. Henry R. Hertzfeld, Senior Research Scientist, Elliot School of International Affairs, George Washington University	
Oral Statement	26
Written Statement	28
Biography	30
Ms. Pamela L. Meredith, Counsel, Zuckert, Scoutt & Rasenberger, LLP	
Oral Statement	31
Written Statement	32
Biography	39
Discussion	
Passenger Indemnification	40
Government Responsibility	43
Effects of Cost on Access to Space	47
The Purpose of Commercial Human Space Flight	48
Effects of a Loss of a Vehicle	48
Determining a Balance of Regulation	49
Experimental Certification	51
RLV vs. EELV	52
Risk	52
Indemnification for Vehicle Operators	56
Indemnification and Industry Survival	57
Manned vs. Unmanned Regulation	57

Page

Appendix 1: Answers to Post-Hearing Questions

Mr. Gary C. Hudson, Chief Executive Officer, HMX, Inc. 60
Mr. Michael S. Kelly, Technical Manager, Northrop-Grumman/Xon Tech 63
Mr. Raymond F. Duffy, Jr., Senior Vice President, Willis InSpace Insurance Underwriters 67
Dr. Henry R. Hertzfeld, Senior Research Scientist, Elliot School of International Affairs, George Washington University 69
Ms. Pamela L. Meredith, Counsel, Zuckert, Scoutt & Rasenberger, LLP 73

Appendix 2: Additional Material for the Record

H.R. 3245, *Commercial Space Act of 2003* 82
Section Analysis of H.R. 3245 93
Prepared Statement by James A.M. Muncy, Space Policy Consultant, PoliSpace 95
A "Clean Sheet" Perspective on Promoting and Regulating the Commercial Space Flight Industry, by Gary C. Hudson, October 28, 2003 101
Statement by Jeff Greason, President, XCOR Aerospace 107

H.R. 3245, COMMERCIAL SPACE ACT OF 2003

WEDNESDAY, NOVEMBER 5, 2003

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON SPACE AND AERONAUTICS,
COMMITTEE ON SCIENCE,
Washington, DC.

The Subcommittee met, pursuant to call, at 10:37 a.m., in Room 2318 of the Rayburn House Office Building, Hon. Dana L. Rohrabacher [Chairman of the Subcommittee] presiding.

COMMITTEE ON SCIENCE
SUBCOMMITTEE ON SPACE AND AERONAUTICS
U.S. HOUSE OF REPRESENTATIVES
WASHINGTON, DC 20515

Hearing on

H.R. 3245 – The Commercial Space Act of 2003

Wednesday, November 5, 2003
10:30 p.m. – 12:30 p.m.
2318 Rayburn House Office Building

WITNESS LIST

Mr. Gary Hudson
Chief Executive Officer
HMX, Inc.

Mr. Michael S. Kelly
Technical Manager
Northrop-Grumman/Xon Tech

Mr. Raymond Duffy, Jr.
Senior Vice President
Willis InSpace Insurance Underwriters

Dr. Henry Hertzfeld
Senior Research Scientist
Elliot School of International Affairs, George Washington University.

Ms. Pamela Meredith
Counsel
Zuckert, Scoutt & Rasenberger, LLP

Section 210 of the Congressional Accountability Act of 1995 applies the rights and protections covered under the Americans with Disabilities Act of 1990 to the United States Congress. Accordingly, the Committee on Science strives to accommodate/meet the needs of those requiring special assistance. If you need special accommodation, please contact the Committee on Science in advance of the scheduled event (3 days requested) at (202) 225-6371 or FAX (202) 225-0891.

Should you need Committee materials in alternative formats, please contact the Committee as noted above.

HEARING CHARTER

SUBCOMMITTEE ON SPACE AND AERONAUTICS
COMMITTEE ON SCIENCE
U.S. HOUSE OF REPRESENTATIVES

H.R. 3245, Commercial Space Act of 2003

WEDNESDAY, NOVEMBER 5, 2003
10:30 A.M.—12:30 P.M.
2318 RAYBURN HOUSE OFFICE BUILDING

A. Purpose

On Wednesday, November 5, 2003, at 10:30 a.m., the House Subcommittee on Space and Aeronautics will hold a hearing to address the legal, regulatory, and public policy ramifications of H.R. 3245, the *Commercial Space Act of 2003,* for the emerging commercial human space flight industry. The entrepreneurs who comprise this industry hope in the near future to provide round trips into space for paying customers. H.R. 3245 proposes to regulate and license domestic commercial human space flight through the Associate Administrator for Commercial Space Transportation (AST) within the Federal Aviation Administration (FAA).[1] The bill also proposes to provide government indemnification to commercial human space flight providers for certain liabilities incurred from launch mishaps.

This hearing will examine the relative merits of regulating commercial human space flight through the AST, or the FAA's Aircraft Certification and Regulations Office (AVR),[2] or through another Government office and, by extension, the manner in which experimental launch vehicles should be regulated. The hearing will also address the merits of providing indemnification to commercial human space flight ventures. The government already offers indemnification to traditional commercial space transportation ventures, such as satellite launch operations.

B. Critical Questions

The following questions were submitted in advance to all of the witnesses:

1. Should the government regulate commercial human space flight? If so, what should the public policy objectives (e.g., encouraging development of the industry, protecting third parties, protecting passengers, etc.) of that regulation be and how should they be balanced?
2. Should the government offer indemnification for commercial human space flight, and if so, against what sorts of liability? How should any indemnification relate to existing policies and international treaties?
3. What changes would you recommend to H.R. 3245? In particular, do you support commercial human space flight being regulated by the Office of Commercial Space Transportation at the Federal Aviation Administration? If not, where and in what manner would you propose to regulate commercial human space flight?

C. Witnesses

1) Gary Hudson is the Chief Executive Officer of HMX, an aerospace services company. Mr. Hudson is the former President and Chief Executive Officer of the Rotary Rocket Company.
2) Michael S. Kelly is a Technical Manager at Northrop-Grumman/Xon Tech, and founder of the Kelly Space and Technology Corporation. Mr. Kelly currently heads the Commercial Space Transportation Advisory Committee's (COMSTAC) reusable launch vehicle working group.

---

[1] In 1985, the FAA created the Office of Commercial Space Transportation (OCST) to regulate and promote the commercial space transportation industry. In 1995, OCST's authority was transferred to the FAA's Associate Administrator for Commercial Space Transportation. This office is commonly known as the "AST."

[2] For historical reasons, the FAA's Aircraft Certification and Regulations Office is commonly known as the "AVR."

3) Raymond Duffy, Jr. is Senior Vice President at Willis InSpace Insurance Underwriters.
4) Henry Hertzfeld is a Senior Research Staff Scientist at the Space Policy Institute Center for International Science and Technology Policy at the George Washington University.
5) Pamela Meredith is of counsel at the law firm of Zuckert, Scoutt & Rasenberger, LLP where she practices aerospace and space law. Ms. Meredith also is an Adjunct Professor of satellite communications and space law at American University's Washington College of Law.

D. Background

The Existing Regulatory Regime for Commercial Space Transportation Launches

Any person or private entity wishing to conduct commercial space transportation activities (generally, satellite launches) in the United States must obtain FAA authorization to do so. Furthermore, U.S. citizens must obtain authorization from the FAA to operate launch or re-entry sites anywhere in the world. The FAA derives this authority from the Commercial Space Launch Act of 1984 (CSLA) and has delegated that authority to the AST. The AST has the dual mandate of regulating and promoting the commercial space transportation industry in the United States.

When the CSLA was enacted, only expendable launch vehicles (ELVs), sounding rockets, and certain types of ballistic missiles were available for private sector use. These vehicles typically are used to lift satellites into orbit. Since enactment of the CSLA, commercial enterprises have pursued the development of reusable launch vehicles (RLVs). A reusable launch vehicle is one that is designed to return from Earth orbit or outer space to Earth substantially intact. Congress amended the CSLA in 1998 to add licensing authority for re-entry vehicles, including RLVs. Proponents of the use of RLVs hope that they may ultimately provide trans-atmospheric high-speed flight around the globe for rapid international travel.

With developmental RLVs designed to fly human beings into outer space, a number of applicants have approached the AST desiring to enter the space launch licensing process. The "hybrid" design of certain of these vehicles and the fact that RLVs are meant to carry human passengers makes the question of how they should be regulated difficult. For example, some RLV concepts are considered "hybrids" because they combine aviation (for example, wings) and space technologies (for example, rocket propulsion). This hybrid quality muddies the regulatory lines of authority over RLVs between traditional space and aviation regulatory authorities. The fact that human beings will be passengers on the RLVs also creates regulatory confusion inasmuch as the established regulatory process for licensing commercial space launches currently does not contemplate human passengers, while aviation regulation has had authority to regulate passenger-carrying vehicles in the past.

Some in the industry believe that the AST should regulate RLVs because the vehicles are designed to reach space and this is the traditional domain of the AST. However, there have been complaints that the AST licensing process is too slow to allow the commercial human space flight industry to grow. Moreover, AST has little experience regulating aviation technologies and no experience regulating vehicles with passengers. As an alternative to regulation by AST, some in the industry believe that the AVR should take the lead in regulation. AVR has a relatively streamlined process in place for certifying experimental aircraft and experience regulating passenger-carrying vehicles. Still others in the industry believe that commercial human space flight should not be regulated whatsoever or they advocate the creation of a wholly new office within the Federal Government to regulate commercial human space flight ventures.

At present, it is not clear what type of regulatory regime would (or should) cover commercial human space flight operations. Specifically, it is not apparent whether a standard commercial space launch license issued by the AST must be issued, or whether an aircraft certification, such as an experimental airworthiness certification, should be issued by the AVR. It should be noted that the FAA recently issued regulations meant to clarify the FAA licensing requirements for hybrid RLVs based on the design of the vehicle and that these regulations mirror the definitions proposed in H.R. 3245. However, the FAA regulations do not (and are not meant to) cover human space flight. Regardless, there is an overall concern that uncertainty about the applicable regulatory regime may impede the ability of developers of systems for commercial human space flight to obtain financing from would-be investors.

Government Indemnification for Commercial Human Space Flight Operations

In 1988, Congress amended the CSLA to indemnify the commercial space launch industry against successful claims by third parties. Specifically, the United States currently agrees to pay third party claims against licensees in amounts up to $1.5 billion above the amount of insurance that a licensee carries. The CSLA's definition of "third party" excludes all government employees, private employees, and contractors involved directly with the launch of a vehicle.

The CSLA requires that private launch companies purchase sufficient liability insurance to cover a minimum amount of damage. This amount is determined by the FAA on a case-by-case basis depending on its calculation of the "maximum probable loss" from claims by a third party.[3] This amount is capped at $500 million for coverage against suits by private entities.

Since the majority of commercial launch activity occurs at national launch ranges (for example, Cape Canaveral and Vandenburg Air Force Base), the CSLA also requires any insurance policy a company obtains to also protect the Federal Government, its agencies, personnel, contractors, and subcontractors.

The liability insurance section of the CSLA requires reciprocal waivers of claims between the licensee and its contractors, subcontractors, and customers. In effect, the licensee and any other organization assisting in the actual launch are preventing from seeking damages from one another.

Since its enactment, the CSLA's indemnification regime has been subject to an expiration date. The expiration date already has been extended by Congress several times. At present, FAA-licensed launch operators are ensured of indemnification under the statutorily prescribed procedures through December 31, 2004. H.R. 3245 extends indemnification through December 31, 2007.

International Law Governing Space Launches

International agreements make clear that the United States bears absolute liability for the international consequences of private American space launches. By setting insurance requirements based on maximum probable loss, as directed by the CSLA, the Government is essentially making a risk estimate that its potential liability under international agreements will be covered by the insurance purchased.

The international law governing the United States' outer space activities consists of four multinational treaties and "customary space law." Two of the treaties, the Outer Space Treaty of 1967 and the Liability Convention of 1972, expressly address issues of third party liability in the international context. Article VI of the Outer Space Treaty places responsibility for all national outer space activities on respective government signatories, even when a launch is conducted by a private organization. The Liability Convention expands the basic international liability concepts set forth in the Outer Space Treaty. To date, there have been no claims under international law for third-party liability resulting from U.S.-licensed commercial launches.

The Regulatory and Indemnification Regime Proposed by H.R. 3245

H.R. 3245 seeks to amend the CSLA by placing authority for the regulation of human space flight activities under the AST. As stated in its findings, the bill means to "create a clear legal and regulatory regime for commercial space transportation, including an unambiguous delineation of regulatory roles and responsibilities."

H.R. 3245 recognizes that with the advent of commercial human space flight there are two new factors with which to deal in the commercial space transportation regulatory and liability risk-sharing regimes: passengers and crew. The bill delineates qualifications that passengers must meet to be eligible for space flight, but does not contemplate qualifications for crew members. The bill also includes a provision requiring a reciprocal waiver of liability claims between licensees and passengers, but the bill is not clear as to treatment of the crew for liability purposes.

H.R. 3245 broadens the existing indemnification regime for commercial space transportation launches to include commercial human space flight launches and extends the indemnification regime by three years. In addition, the bill directs the Secretary of Transportation to arrange for the National Academy of Public Administration (NAPA) to conduct a study on the existing liability-risk sharing regime for commercial space transportation.

---

[3] In the alternative to purchasing adequate insurance, private launch companies must demonstrate that they have adequate resources to cover all potential losses.

Chairman ROHRABACHER. I hereby call this meeting of the Space and Aeronautics Subcommittee to order. And without objection, the Chair will be granted the authority to recess this committee at any time. Hearing no objection, so ordered.

At today's hearing, we will examine the topic of commercial human space flight as it relates to H.R. 3245, the *Commercial Space Act of 2003,* a bill I have sponsored and Bart Gordon cosponsored. We will explore whether launch vehicles that carry people to outer space merits government indemnification, especially if those vehicles are private sector vehicles, and whether current regulatory processes needed to be—or need to be changed or whether legal regimes for protecting passengers and crew as well as the uninvolved public are adequate. I believe space entrepreneurs offer great hope for our troubled space transportation industry by introducing new, innovative concepts and yes, as being examples and inspirations to people within the industry and within government.

Testimony given at a joint hearing between this subcommittee and its Senate counterpart last July revealed that government regulations are pivotal in the early development of space entrepreneurial ventures, however, bureaucratic red tape simply can't be allowed to impede the growth of such promising industries. As Ronald Reagan, a fellow I used to work for, once observed when signing the first Commercial Space Act 20 years ago: "We need to cut red tape to see blue sky." However, there is something about the color of the sky that may not be right in that quote, because what we are looking for is not blue sky, but we are looking to go beyond blue sky.

And that said, the FAA's Space Transportation Office has announced a determination of a licensed application for the first passenger carrying RLV and that it has—this application has been completed, which means that the 180-day clock for the license approval process has begun for a sub-orbital RLV manufacturing company. This is a major first step for the industry and a hopeful sign for the future of commercial human space flight. I believe H.R. 3245 will help nurture this emerging commercial human space flight industry. We owe our support to those individuals who continue to push the boundaries of the new frontiers that are—that confront us and especially those in the commercial space transportation industry.

Critical areas where H.R. 3245 is silent or lacks clarity will be examined and explored today so that the legislation can be strengthened in preparation for a markup early next year in the Full Committee. The bipartisan support already demonstrated for this bill demonstrates a bipartisan support for the concept, and let us get moving on it. And we may have changes based on your testimony today. But if—but the bipartisan support will ensure that we do move forward and that we are taking your observations and your recommendations that you have for us today very seriously. So the expert witnesses we have assembled will help us achieve this end.

[The prepared statement of Chairman Rohrabacher follows:]

PREPARED STATEMENT OF CHAIRMAN DANA ROHRABACHER

Today's hearing will examine the topic of commercial human space flight as it relates to H.R. 3245, the *Commercial Space Act of 2003,* a bill I've sponsored and Bart Gordon co-sponsored. We will explore whether launch vehicles that carry people to outer space merits government indemnification, whether current regulatory processes need to be changed, and whether legal regimes for protecting passengers and crew, as well as the uninvolved public, are adequate. I believe space entrepreneurs provide a beacon of hope for our troubled space transportation industry by introducing innovative concepts.

Testimony given at a joint hearing between this subcommittee and its Senate counterpart last July revealed that government regulations are pivotal in the early development of space entrepreneurial ventures. However, bureaucratic red tape simply can't be allowed to impede the growth of such promising industries. As Ronald Reagan observed when signing the first Commercial Space Act twenty years ago, "we need to cut real red tape to see blue sky."

That said, the FAA's space transportation office has announced that a determination of a license application for the first passenger-carrying RLV has been completed. This means that the 180-day clock for the license approval process has begun for a sub-orbital RLV manufacturing company. This is a major first for the industry, and a hopeful sign for the future of commercial human space flight. I believe H.R. 3245 will help nurture this emerging commercial human space flight industry.

We owe our support to those individuals who continue to push the boundaries of new frontiers in the commercial space transportation industry. Critical areas where H.R. 3245 is silent or lacks clarity will be explored today, so that the legislation can be strengthened in preparation for markup early next year.

The bipartisan support already demonstrated for this bill will ensure its success in moving forward in a careful and deliberative way within the Committee. The expert witnesses we have assembled will help us achieve that end.

Chairman ROHRABACHER. And now I would turn to our Ranking Member, Mr. Gordon, for his opening statement.

Mr. GORDON. Thank you, Mr. Chairman, and good morning.

I want to add my welcome to the witnesses to today's hearing, and I look forward to a good exchange of views.

As Chairman Rohrabacher has said in his opening statement, we will be discussing a number of provisions in this—in his commercial space bill H.R. 3245. I am happy to be an original co-sponsor of this bill, as I believe we need to clarify the congressional intent with respect to the emerging commercial human space flight industry. Of course, as today's testimony will bear out, we are dealing with complex issues, and there are varying points of view. As I stated at last month's Subcommittee markup of this legislation, we all will benefit from further discussion and provisions of the Chairman's bill. And I welcome today's hearing as an important first step.

There are several items, in particular, that I hope the witnesses will address. For example, at least one of the witnesses argues that we should not extend existing indemnification provisions to the commercial human space flight industry. I hope he will elaborate on this—on his rationale. And I would like to hear the other witnesses given their views on the topic. In addition, it appears that some of the witnesses at today's hearing, and at July's joint hearing with the Senate, would argue for a hands-off approach by the Government relative to passenger safety on these systems. Will such an approach be sufficient? And is there going to be a point at which the Government is going to have to get involved as it is in the aviation industry?

I would also like to hear what they think the industry should do ensuring safety—or passenger safety if the Government is to get involved.

Well, there is a lot to talk about today, and once again, I am glad you are here.

And Mr. Chairman, I yield back my time.

Chairman ROHRABACHER. Thank you very much.

And without objection, the opening statements of other Members will be put into the written record so we can get right to the testimony. Hearing no objection, so ordered.

I also ask unanimous consent to insert at the appropriate place in the record and the background memorandum prepared by the Majority staff for this hearing. And hearing no objection, so ordered.

And before beginning, I also ask unanimous consent to insert at this point in the record the written testimony that I have invited from Jim Muncy on this legislation. Without objection, so ordered. *[Note: The prepared statement of Mr. Muncy appears in Appendix 2: Additional Material for the Record.]*

I further ask unanimous consent that the record for this hearing remain open until November 12, 2003 so that the public may provide additional written testimony for the record on H.R. 3245 and that testimony may be inserted into the record. Without objection, so ordered.

And we do have a distinguished panel with us today to provide their unique perspective on the critical issues that we are examining. We have asked them, and I would ask them to summarize, if you may, or points to—if you get—if you can summarize in five minutes. That means we are going to really pay attention to the most important points that you have to make, but the longer you go over five minutes, the less attention we are going to pay to your most important points. So we would hope that you could summarize and focus on those things that are most contentious and the things that you want to convey. However, your full testimony will be made part of the record. And we will be looking at that as we move forward with this legislation.

Our first witness is Gary Hudson, who is the Chief Executive Officer of HMX, an aerospace services company. Mr. Hudson is the former President and Chief Executive Officer of Rotary Rocket Company. And Mr. Hudson, you may now proceed.

STATEMENT OF MR. GARY C. HUDSON, CHIEF EXECUTIVE OFFICER, HMX, INC.

Mr. HUDSON. Mr. Chairman, Members of the Subcommittee, I have timed this at exactly five minutes, so we will see if I am close.

I have 34 years of experience in promoting commercial space transportation, and I always intend, even in my current semi-retirement, to continue to speak my mind, so thank you for listening.

Today, there is an argument raging in the emerging launch industry: How should piloted space flight vehicles be regulated?

The origin of this debate goes back two decades. At the time, private rocketeers faced a number of federal agencies, each of whom claimed they were in charge. These ranged from the FAA, which had the legitimate authority under the then existing law, to the Department of State, which wanted to regulate rocket launches under the absurd notion that they were exports. The professed goal of the sponsors of the first Commercial Space Act was to put an

end to this problem and provide a one-stop-shop for launch approvals. I supported that unreservedly.

But I lost the battle to limit the scope of the Act. Instead, a completely new entity was created, the Office of Commercial Space Transportation, as well as a new concept, federal launch license. At the time, some of us complained this new entity was not needed, that the existing law was adequate with minor revisions, that the new OCST would not be able to figure out what to do about piloted reusable rockets. Our concerns were brushed aside. They have now emerged as crucial to the future survival of an industry in crisis.

Some may be concerned that I stand in opposition to H.R. 3245. This is decidedly not so. I do support it, and with additions, as you have mentioned, Mr. Chairman, wish to see it passed. I applaud those who have worked hard to bring it to this body, and I will be happy to work with you to improve the wording of the Act to address certain issues. One of these issues is the perception of risk.

It is my duty to remind this committee that there has been no third-party injury since the beginning of the Space Age in the Western world. During the past 20 years, we have spent tens of millions of taxpayer dollars funding AST and, before it, OCST. In the next decade, we will spend over $100 million more just for regulation. My question to our industry and to this Congress is: Have these funds made us safer that if we had retained our previous regulatory structure under prior Federal Aviation Regulations? I think the answer is unambiguously: No.

AST has grown increasingly bureaucratic. Launch license are now major federal actions. In spite of my warnings and counsel of the past five years, we have now reached a crisis. Experiment flight-testing of sub-orbital passenger vehicles has begun. AST is not up to the challenge of this development. Therefore, I recommend its dis-establishment and the elimination of the need for U.S. persons to seek launch licenses. In its place, I propose we return to the pre-1984 law governed by the Federal Aviation Regulations. This will be sufficient to protect the safety of third parties and to fulfill international obligations. Piloted rocket aircraft of a variety of types would then be regulated under the—by the FAA under "experimental" type certificates. Several rocket aircraft have already been issued such type certificates.

The strongest objection to such an approach comes from my good friends and colleagues who wish to begin offering passenger rides and who fear the cost of FAA standard type certification. I understand their position and I sympathize. And I believe a barnstorming era for space transportation is desperately needed, but we can reach that result by forthright action of a different type.

Current FAA rules generally prohibit revenue flying of experimental aircraft. I propose we simply change the rule. Congress can permit certain experimental type certified aircraft defined as space vehicles to operate under a limited exemption for a period of time, call it 20 years. Coincidentally, this time is the same period from the Wright Brothers' first flight to the establishment of the first Civil Aeronautics Authority by this—Congress in 1926. Some have asked: "How do we protect the passengers on those flights?" H.R. 3245 correctly supplies the solution by defining "space flight participants" as someone who would give their informed consent to fly.

Another issue is liability. In 1972, the U.S. Government unwisely assumed responsibility for worldwide third party liability from space launches from any U.S. person. Fortunately, the letter of the treaty can be satisfied by requiring that individual launch operators obtain liability insurance. Indeed, this is a current AST requirement.

Interestingly, a similar system as I propose is in place for commercial launches in Russia. There are no launch licenses, no environmental impact statements, no two-year process costing hundreds of thousands or millions of dollars. Provide your insurance certificate, submit proper notifications, and you are good to go. How is it that the bureaucrats of the former Soviet Empire can be more rational and sensible than we?

And I am afraid the Chairman has stolen my thunder, because I say signing the first Commercial Space Act 20 years ago, Ronald Reagan said: "Let us cut red tape to see that blue sky." And I say let us finally do as he wished.

Thank you.

[The prepared statement of Mr. Hudson follows:]

PREPARED STATEMENT OF GARY C. HUDSON

Mr. Chairman, Members of the Subcommittee:

I have spent thirty-four years of my life promoting commercial space transportation, and intend—even in my current semi-retirement—to continue to speak my mind. Thank you for listening.

Today there is an argument raging in the emerging launch industry. How should piloted human space flight vehicles be regulated?

The origin of the debate goes back two decades. At that time, private rocketeers faced a number of federal agencies each who claimed they were in charge. These ranged from the FAA, which had the legitimate authority under the existing law, to the Department of State, which wanted to regulate rocket launches under the absurd notion that they were "exports." The professed goal of the sponsors of the first Commercial Space Act was to put an end to this problem and provide a "one-stop-shop" for launch approvals. I supported that unreservedly.

But I lost the battle to limit the scope of the Act. Instead, a completely new entity was created: the Office of Commercial Space Transportation, as well as a completely new concept: "Federal launch licenses." At the time, some of us complained that the new entity wasn't needed, that the existing law was adequate with minor revisions, and that the new OCST would not be able to figure out what to do about piloted reusable rockets. Our concerns were brushed aside. They have now emerged as crucial to the future survival of an industry in crisis.

Some in this industry may be concerned that I stand in opposition to H.R. 3245. This is decidedly not so. I do support it and, with additions, wish to see it pass. I applaud those who have worked hard to bring it before this body. I will be happy to work with you to improve the wording of the Act to address certain issues. One of those issues is the perception of risk.

It is my duty to remind this committee that there has been no third party injury since the beginning of the Space Age in the Western world. During the past 20 years, we have spent tens of millions of taxpayer's dollars funding AST and before it, OCST. In the next decade we will spend over $100 million more. Just for regulation! My question to our industry and this Congress is: have these funds made us safer than if we had retained our previous regulatory structure under previous Federal Aviation Regulations? I think the answer is unambiguously *no.*

AST has grown increasingly bureaucratic. Launch Licenses are now Major Federal Actions. In spite of my warnings and counsel of the past five years, we have now reached a crisis. Experimental flight-testing of sub-orbital passenger vehicles has begun. AST is not up to the challenge of this development. Therefore, I recommend the dis-establishment of AST, and the elimination of the need for US persons to seek "launch licenses." In its place, I propose that we return to the pre-1984 law governed by Federal Aviation Regulations. This will be sufficient to protect the safety of third parties and to fulfill international obligations. Piloted rocket aircraft

of a variety of types will then be regulated by the FAA under "experimental" type certificates. Several rocket aircraft already have been issued such certificates.

The strongest objection to such an approach comes from colleagues who wish to begin offering immediate passenger rides who fear the cost of FAA certification. I understand their position, and sympathize. And I believe that a barnstorming era for space transportation is desperately needed. But we can reach that result by other forthright action.

Current FAA rules generally prohibit revenue flying of experimental aircraft. I propose we simply change the rule. Congress can permit certain experimental aircraft defined as space vehicles to operate under a limited exemption for a period of time—20 years. Coincidentally this is the same period from the Wright Brothers first flight to the establishment of the first Civil Aeronautics Authority in 1926. Some have asked how we protect the passengers on these flights? H.R. 3245 correctly supplies the solution by defining "space flight participants" as someone who would give their informed consent to fly.

Another issue is liability. In 1972 the U.S. government unwisely assumed responsibility for worldwide third party liability from space launches by any U.S. person. Fortunately, the letter of the treaty can be satisfied by requiring that individual launch operators obtain liability insurance. Indeed, this is a current AST requirement.

Interestingly, a similar system is in place for commercial launches in Russia. There are no launch licenses, no environmental impact statements, and no two-year process costing hundreds of thousands or millions of dollars. Provide your insurance certificate, submit proper notifications, and you are good to go. How is it that the bureaucrats of the former Soviet Empire can be more sensible than we?

Signing the first Commercial Space Act twenty years ago, President Ronald Reagan said we would "cut red tape to see blue sky." Let us finally do as he wished.

Thank you.

Subcommittee Questions:

Q1. Should the government regulate commercial human space flight? If so, what should the public policy objectives (e.g., encouraging development of the industry, protecting third parties, protecting passengers, etc.) of that regulation be and should they be balanced?

1. This is an excellent question. The air travel industry experienced it's "barn storming" era and operated for over 20 years before the creation of the Civil Aeronautics Administration in 1926. Commercial human space flight needs a similar period of minimal regulation to reach its full potential. Promotion of the industry should be encouraged, and the best means to accomplish this will be a light regulatory hand. Regulation should be confined, for at least the next twenty years, to protecting third parties. Passengers need no protection in the near-term, since no one can be imagined to be engaging in this experience who is not appraised of the risks. I favor having an "informed consent" requirement for these second parties.

Q2. Should the government offer indemnification for commercial human space flight, and if so, against what sorts of liability? How should any indemnification relate to existing policies and international treaties?

A2. I do not believe that the government should provide any indemnification whatsoever to first or second parties (vehicle operators or passengers). I believe the government should require operators of commercial human space flight vehicles to obtain third party liability insurance with the U.S. Government as a named insured as is currently required. This is consistent with the requirements of international law, including the 1972 Liability Convention. I do not see why the commercial space industry requires indemnification to succeed when third party risks are virtually non-existent. In the past fifty years there have been no third party injuries or fatalities from space launches in the Western world. Ideally, I would like to see the U.S. withdraw from the 1972 Liability Convention or renegotiate it to a regime more in keeping with the liability limits that were placed on international air travel operations by the Warsaw Convention. There is no rational reason why the actions of a U.S. person should implead the U.S. government in tort claims.

Q3. What changes would you recommend to H.R. 3245? In particular, do you support commercial human space flight being regulated by the AST? If not, where and in what manner would you propose to regulate commercial human space flight?

A3. I recommend the following changes to H.R. 3245:

1) Clarification that vehicle operators, and not the government, are to set the medical and other standards by which they accept "space flight participants" into their programs;
2) Dis-establishment of AST.
3) Direction to FAA to permit experimental space flight vehicles to be operated for profit, with the added requirement that third party liability insurance be provided by vehicle operators identifying the U.S. government as a "named insured."
4) Elimination of "launch licenses" in favor of reapplication of FAR 101, with appropriate minor changes, to conduct unmanned rocket launches.

I do not support commercial human space flight being regulated by AST. I recommend dis-establishment of AST for the reasons sited in my testimony. I recommend that commercial human space flight be regulated within the FAA by AVR (Regulation and Certification Group) under the "type certification" environment used for all other aerospace vehicles.

Additional Frequently Asked Questions:

Q1. You favor elimination of AST. Isn't that a radical solution?

A1. I prefer to think that saving $100 million+ over the next decade, by dis-establishing AST now, is the far more rational solution. If third parties were really at seriously high risk from space launch activity, there would be a legitimate argument for AST's continued existence. But the record shows that modern space launch of any type (orbital or sub-orbital, manned or unmanned) is essentially free from measurable risk to third parties.

It should also be noted that AST has 70 or 80 staff at any one time, who do nothing all day but study what new regulations they think might be desirable, process license applications or think up new requirements for industry. At the same time, the *entire* sub-orbital human space flight industry does not have as many engineers and technicians *actually building the vehicles!* Regulators actually outnumber the people doing the work; this would be considered a parody of regulatory behavior in almost any other area of human endeavor. For example, what if the FDA had as many regulators as there were physicians?

Q2. Who would be in charge of regulation if AST is dis-established?

A2. The same organization that had regulatory responsibility for private rocket activities prior to the formation of OCST in 1984, the FAA via FAR 101.

Regarding Unmanned Rockets. Given that unmanned rockets have to be launched from specialized facilities established by federal or State authorities, that are regulated at the local, county, State and national level by environmental rules, air traffic rules and many other health/safety laws and regulations, there is simply no need for an additional overarching level of bureaucracy to control launch facilities or rockets. These facilities establish detailed safety regulations to which all launch operators must adhere. AST is not needed to assure that launch operators of unmanned rockets abide by these rules and regulations, since the operator will not be allowed to fly if they fail to comply with range rules. AST adds no *safety* to unmanned operations but *costs* launch operators hundreds of thousands to millions of dollars in added regulatory compliance each year.

Regarding Human Space Flight Vehicles. Piloted vehicles can be regulated as aircraft per the Federal Aviation Regulations. They should be allowed to operated from the same categories of airfield that more conventional experimental aircraft do; when fully certificated, they should be allowed to operate wherever certificated aircraft may, subject to noise and emission regulations.

Q3. AST says they will "tailor" launch licenses to permit experimental flights. Isn't this a reasonable solution to the problem of experimental flight-testing?

A3. No. When a research aircraft developer gets experimental type certification, the developer may fly as frequently as he wishes, when he wishes, and may make modifications to his aircraft during the test program without obtaining further certification approval from the FAA. By contrast, AST has not yet developed their "tailored" rules, but appears to want far more restrictions that those which are imposed on *any* experimental aircraft to date, even though the sub-orbital vehicles being proposed (or flying) have virtually no potential for third party harm. Even if they adopted the exact same rules as FAA/AVR, they would be an unnecessary and expensive redundancy. AVR can do the job, with no additional staff or funds, if the job is re-scoped away from being a "license" invoking the specter of a Major Federal Action.

Q4. You refer to "aircraft" but many piloted space launch concepts are not winged airplanes. How would these be regulated?

A4. According to the legal definitions in the FARs, "aircraft" is *any* device that flies in or though the air. Since physically all space vehicles *must* fly through the air on their way to space, they are *already by definition* aircraft. The FARs regulate many types of aircraft that are not "fixed wing" such as rotorcraft, gliders and powered-lift vehicles as well as rockets. In fact, if the current AST approach followed the only type of aircraft not covered by the FARs would be piloted sub-orbital space launch vehicles. This makes no sense. One class of vehicle should not be taken completely outside of the FARs simply to justify the existence of an entity (AST) that is not needed in the first instance; an exemption should be made to allow that specific class to of aircraft to be operated for profit within the FARs.

Q5. Isn't certification very expensive?

A5. That depends. Certification costs vary widely, and much nonsense is spoken about them. There are many levels of type certification. So called "standard type certification" is only one of them. It is true that the certification costs for a new Boeing commercial aircraft may be hundreds of millions of dollars. Smaller, four-place, general aviation aircraft are routinely certificated for much less. If this was not so, no new general aviation aircraft would be built. Yet new models are being introduced every year, ranging from trainers to light jets. The perceived impediment of "standard type certification" would be obviated in the near-term (for the next two decades) if we adopt my suggestion to permit experimentally type certificated space vehicles to be flown, with limitations, for profit. This is a "no cost" solution. Full standard type certification would not be mandated for 20 years.

When one considers the multiplicity of "plans," documents, reviews, meetings, tests and acceptances now being required by AST to obtain a reusable launch vehicle license, the cost of "certification" vs. the cost of RLV "licensing" seems to have become comparable in both time and dollars. The ultimate difference is that RLV licensing is being done by an entity with no experience providing true certification expertise to the operator, while the FAA/AVR has certified thousands of different aircraft types. Furthermore, once an operator has a type certificate, the vehicle may be flown without any further notification or permissions (excepting a flight plan) while AST requires 60 day advance notification of every flight, and intrusive and burdensome inspections, reviews and further approvals to operate once a license has been granted.

Q6. Is there any example of experimental type certificated aircraft being operated for hire today?

A6. Yes. The FAA now allows experimental type certificated aircraft to be rented to certified flight instructors, who may then use them to train student pilots. This is operation for hire and is a recent exemption to the rule. The rationale for letting student pilots pay to fly in an experimental aircraft is the same as I propose for "informed consent space flight participants;" that is, the student pilot, by virtue of his or her training, knows the risks and is able to make a judgment to accept or reject the risks. The sub-orbital or orbital space flight participant would be assumed to be capable of the same judgment. The space flight participant will not be walking up to a ticket window and buying a seat; it is widely expected that they will undergo instruction and orientation training by the firms offering the flights prior to being accepted to fly.

BIOGRAPHY FOR GARY C. HUDSON

Mr. Hudson, 53, was a founder and Chairman of the Board of Directors of Rotary Rocket Company, and is a founding principal of HMX, Inc., an aerospace consulting and engineering firm. He is also founder and Operating Manager of AirLaunch LLC, a startup currently working on a military launch system for the Defense Applications Research Agency (DARPA).

Mr. Hudson has worked in the field of commercial space for over 34 years with an emphasis on development of innovative low-cost systems. In 1981, he built the first large private launch vehicle developed in the U.S. He is also the designer of the *Phoenix* VTOL/SSTO family of launch vehicles which led to the DC–X Delta Clipper project. He has participated in many launch vehicle projects including support for both General Dynamics and Boeing Aerospace Corporation during the SDIO program. He has published many papers on space vehicles and systems and has authored several studies on low cost propulsion systems. At Rotary he managed the

successful *Roton* ATV program, the only piloted reusable launch vehicle demonstrator to have flown since the Space Shuttle *Enterprise*.

In 1994 he co-founded HMX, which designs and develops innovative aerospace propulsion systems. In 1995 HMX developed a rocket engine propulsion system for Kistler Aerospace Corporation. HMX also provided early propulsion support to Scaled Composites for the *SpaceShipOne* project, participated in the NASA Alternate Access to Space concept study contract in 2000, and participated in the Phase I Concept definition for the DARPA RASCAL project. HMX also developed the DARPA MIPCC Test Bed, a sophisticated test facility located at Mojave, CA used to qualify the Mach 4 jet engines used in the RASCAL first stage.

In 1982 he co-founded Pacific American Launch Systems, Inc. where he was directly responsible the design and development of the *Liberty,* a small expendable launch vehicle using an innovative pintle rocket engine, which underwent prototype engine testing for the U.S. Army Strategic Defense Command on behalf of SDIO at Edwards Air Force Base, California. During this period he also served as a consultant to the United States Air Force's "Project Forecast II." He is a former Board Member of the Space Transportation Association, a founder of the STA Space Tourism Division, a member of the Board of Advisors of the Space Frontier Foundation and has presented testimony before the U.S. Congress on several occasions.

Mr. Hudson has conducted seminars for the U.S. Naval Postgraduate School, and the Institute for Space and Astronautical Sciences of Tokyo University and taught graduate-level launch vehicle design at Stanford University. He is a Fellow of the British Interplanetary Society and a Senior Member of the American Institute of Astronautics and Aeronautics. In January 1994 he received the "Laurel" award from *Aviation Week & Space Technology* "for the vision, drive and competence that have pushed [reusable launch vehicles] to the front of the U.S. launcher agenda."

Chairman ROHRABACHER. You know, I will have to admit, I was Ronald Reagan's speechwriter, so——

Mr. HUDSON. I am well aware, Mr. Chairman.

Chairman ROHRABACHER. Thank you very much for your testimony. And you have made some very provocative points. I thank you very much.

Our second witness is Mr. Michael Kelly, who is a technical manager at Northrop-Grumman. And is it pronounced—is it Exxon? Is it like the—do you pronounce it like Exxon like the gasoline or——

Mr. KELLY. No, Xon Tech is the name.

Chairman ROHRABACHER. Xon Tech.

Mr. KELLY. However, I must say that I am testifying as a private individual today.

Chairman ROHRABACHER. All right. And also, with your background, however, you are a founder of the Kelly Space Technologies Corporation. Mr. Kelly currently heads the Commercial Space Transportation Advisory Committee's Reusable Launch Vehicle Working Group. And Mr. Kelly, you may proceed, and we understand you are speaking for yourself today. Thank you very much for being with us.

STATEMENT OF MR. MICHAEL S. KELLY, TECHNICAL MANAGER, NORTHROP-GRUMMAN/XON TECH

Mr. KELLY. Thank you, Mr. Chairman and Members of the Subcommittee, for giving me this opportunity to once again testify on the issues of crucial importance to the future of space transportation.

The issue that we are talking about today is the regulation of a future industry: the RLV industry. The first question that has been asked is the right one, and that is: "Does the United States Government have any legitimate reason to regulate the RLV industry at all?" Not every activity of human beings needs to be regulated. I am glad this was the first question. If there is a requirement for

government regulation, that requirement can be identified, and I believe that all subsequent questions can be answered in the context.

My position is that there is a legitimate requirement for the regulation of RLVs or any commercial space flight by the Government for only the following reasons: defining and enforcing the boundaries of action that protect the lives and property of one group of people from the actions of another has always been the proper function of government; RLV operations are hazardous, the hazards are not all known, I might add, and they are hazardous to uninvolved parties domestically and even abroad for orbital operations; the job of coordinating national and international safety is a large one and it requires the action of the Federal Government; and there are other international considerations, such as treaty compliance, that can be handled only by the Government.

Now these are the requirements for government regulation, and there should be no regulation beyond what is required. When it comes to passenger flight, people who have the financial means and the desire to fly as passengers on an RLV have the absolute right to do so. The government has no legitimate authority to restrict that activity.

Now the office designated to license commercial space launch is the FAA/AST, Office of the Associate Administrator for Commercial Space Transportation. It was established to ensure public safety while promoting the commercial space industry. With regard to who should regulate the flight of commercial RLVs carrying paying passengers, it should, in my opinion, be AST. But the extent of that regulation should not reach beyond AST's charter of protecting the lives and property of uninvolved parties. In other words, there should be no regulation, per se, of human passenger flight, only regulation of routine RLV operation.

I have supported the division of AST from FAA/AVR, which regulates aviation, because the two have different and incompatible charters. AVR regulates an industry with an 80-plus-year revenue history and a 100-year technology history. It applies the vast experience gained over that time to ensure that anyone can board an airplane as a paying passenger without undue fear of losing life and limb and that uninvolved parties on the ground do not bear undue risks from the operation of aircraft.

There is no similar body of experience with which to regulate RLVs. There has only been one type of reasonable space launch vehicle, the X–15, that has ever flown. In an accumulated 199 flights, there was one fatal accident and several non-fatal incidents and one instance of property damage to uninvolved third parties, the only RLV flight experiences thus demonstrated the need for a legal authority.

However, AVR and AST have institutionally different roles. AVR regulates a mature industry. AST is a relatively new office that regulates an industry that doesn't yet exist and that will not exist if regulated as a mature industry. AVR applies lessons learned and is slow to allow innovation in commercial aviation precisely because it does not wish to stray from what has worked. There are virtually no lessons to apply to RLVs, and certainly none that

would apply to all of the types of RLVs that are envisioned or may be envisioned.

My own personal experience, as a member of the RLV industry and as Chairman of the COMSTAC RLV Working Group, is that AST is primarily an organization that lives up to its charter of protecting the lives and property of uninvolved parties while promoting the commercial space industry. There is room for improvement. Application of rules is being done for the first time, and both AST and developers have to learn how to satisfy these rules.

We are seeing that the rules themselves can be improved. The "Final Rule" on licensing of commercial RLVs is the best we could do at the time. It was written before any RLVs entered development. And it is flawed. I, therefore, believe that AST should be mandated to periodically perform a zero-base review of its rules and revamp them as required. This is the best way to continuously incorporate the lessons learned in what will be a very long learning process while preventing the resulting rules from becoming mountains of corrections of previous mistakes.

From the discussion of licensing and its purpose, the question of indemnification can be addressed. Since AST space flight licensing requires demonstration of safety of uninvolved parties and their property, it is not unreasonable to ask the Government to indemnify those flights. In fact, if there is one thing I have learned, it is that the only test of seriousness is the willingness of people to put up money. If the Government issues a launch license and therefore says it is safe for that vehicle to fly, that license only has meaning if the Government is willing to share the burden of the consequences of an accident. Though I support indemnification of the RLV industry when it comes to third-party life and property loss, I support it with respect to passenger flights with less enthusiasm, because it does serve a means of promoting the industry, and the risk to the Government is fairly small. As part of the changes to indemnification, however, I believe that we ought to reexamine the magnitude of what we always thought a realistic number was for the maximum probable loss.

The final issue to be addressed here is where the regulatory body for human passenger space transportation should be located. I have already stated my position that I believe AST to still be the regulatory office of choice and will maintain that position as long as AST fulfills its charter.

Another question is whether AST should be part of the FAA or moved to another place. I think the advantages of being within the FAA, which regulates the national airspace, are overwhelming, and I, therefore, believe that AST should remain within FAA with one powerful proviso: when it comes to matters of commercial space flight, the Associate Administrator for Commercial Space Transportation has to have the last word. Much controversy could be avoided and uncertainty removed if such a mandate existed.

The concept of AST as a "clean sheet of paper" organization that can grow with an emerging industry is what I supported from the beginning. I see no fundamental flaws and nothing that can not be corrected. I think that, overall, we are on the right track with AST, and I think that the *Commercial Space Act of 2003* will play a

large, positive part in helping AST bring the commercial RLV industry into being.

[The prepared statement of Mr. Kelly follows:]

PREPARED STATEMENT OF MICHAEL S. KELLY

Mr. Chairman, and Members of the Subcommittee on Space and Aeronautics, thank you for giving me the opportunity to once again testify on issues of crucial importance to the future of space transportation.

The issue before us today is the regulation of a future industry, the "Reusable Launch Vehicle" (RLV) industry, specifically in its application to carrying paying passengers. The very first question to ask in this regard is: does the United States Government have any legitimate reason to regulate the RLV industry at all? Put a different way, is there a *requirement* from the people of the United States for such regulation? If so, the requirement can be identified, and all subsequent answers can be answered in a context.

My position is that there is a legitimate requirement for regulation of RLVs (or any commercial space flight) by the government, for *only* the following reasons:

- Defining and enforcing the boundaries of action which protect the lives and property of one group of people from the actions of another has always been the proper function of government
- RLV operations do pose a hazard to uninvolved parties, domestically and even abroad (for orbital operations)
- The job of coordinating national and international safety is a large one, requiring the action of the Federal Government
- Other international considerations, such as treaty compliance, can be handled *only* by the government

These are the *requirements* for government regulation, and there should be no regulation beyond what is *required*. People who have the financial means and the desire to fly as passengers on an RLV have the absolute right to do so. The government has no legitimate authority to restrict that activity.

The office designated to license commercial space launch is the FAA/AST. It was established to ensure public safety while promoting the commercial space industry. With regard to who should regulate the flight of commercial RLVs carrying paying passengers, it should in my opinion be AST. The *extent* of that regulation, however, should not reach beyond AST's charter of protecting the lives and property of uninvolved parties.

Today there is a licensing regime for commercial RLVs that meets the AST charter. It need not be extended in order for RLVs to carry paying passengers. The *Commercial Space Act of 2003* contains language requiring disclosure to paying passengers, and if that is met, those passengers are no longer uninvolved third parties. They are as informed as the hundreds of astronaut candidates who spend careers competing for a ride on the Space Shuttle, knowing full well the dangers involved.

It is critical to note the difference between travel on an airline and a ride on an RLV. An airline is a routine mode of transportation, a "common carrier" if you will. People have come to expect a degree of safety in air travel that is without parallel in transportation, or in fact in any other human activity. Space flight is years from being routine, or even a mode of transportation per se. Transportation refers to reaching a desired destination. Space flight, for the foreseeable future, will be an end in itself.

The type of regulation over a common carrier that demands the level of safety of air travel is different in kind from that pertaining to what can only be classed as an adventure ride.

I have supported the division of AST from FAA/AVR, which regulates aviation, because the two have different and incompatible charters. AVR regulates an industry with an 80+ year revenue history, and a 100-year technology history. It applies the vast experience gained over that time to insure that anyone can board an airplane as a paying passenger without undue fear of losing life or limb, and that uninvolved parties on the ground do not bear undue risk from the operation of aircraft.

That vast experience came at a price, and was applied very late in history. There were fatalities among aircraft developers, passengers, and uninvolved parties. Even with regulation from AVR, there are still fatalities and loss of property among passengers and uninvolved parties. I do not question that AVR plays a large role in reducing such incidents, and as I have noted, has made air travel a uniquely safe human activity. This is possible precisely because there have been so many incidents to serve as hard lessons.

There is no similar body of experience with which to regulate RLVs. Only one type reusable space launch vehicle, the X–15, has ever flown. Three were built, two survive. They accumulated 199 flights, with one fatal accident, several non-fatal incidents, and one instance of property damage to an uninvolved third party. Thus, the only RLV flight experience has demonstrated the need for a legal authority.

However, AVR and AST have institutionally different roles and outlooks. AVR regulates a mature industry. AST is a relatively new office that regulates an industry that doesn't yet exist, and that will not exist if regulated as a mature industry. AVR applies lessons learned, and is slow to allow innovation in commercial aviation precisely because it does not wish to stray from what has worked. There are virtually no lessons to apply to RLVs, and certainly none that would apply to all the types of RLVs that are envisioned or may be envisioned.

All of the lessons of the RLV industry lie ahead. Learning them requires freedom, the freedom of developers to use technology that is unfamiliar and unacceptable to AVR, and the freedom to fly paying passengers who knowingly accept the risks. These things are not within the cultural scope of AVR, and it is unreasonable (and even unwise) to expect that to change. AST has a culture that is open to more, by disposition as well as charter.

It is worth asking how AST is performing its role. The experience of RLV industry members to date has been mixed. Those in various stages of discussions of launch licenses report differing impressions, good and bad. Given the wide range of personalities involved, this should be no surprise. AST is an organization of human beings, in a new field, interacting with other human beings. There are going to be disagreements and disappointments.

My own personal experience, as a member of the RLV industry, and as Chairman of the COMSTAC RLV Working Group, is that AST is *primarily* an organization that lives up to its charter of protecting the lives and property of uninvolved parties while promoting the commercial space industry. There is room for improvement, naturally. Application of rules is being done for the first time, and both AST and developers have to learn how to do satisfy those rules.

We are also seeing that the rules themselves can be improved. The "Final Rule" on licensing of commercial RLVs was written before the first commercial RLV entered development, and that rule has already proven itself flawed. We in the industry helped write it, and it was the best all of us knew how to do at the time. But if we had it to do over again, there are things we all now know would be done differently.

If there is to be a change made to the *Commercial Space Act of 2003* with respect to AST, it would be to mandate that the office periodically perform a zero-base review of its rules, and revamp them as required. In my view, this is the best way to continuously incorporate the lessons learned in what will be a very long learning period, while preventing the resulting rules from becoming mountains of corrections of previous mistakes.

There is one onerous aspect of AST that is a consequence of when it was formed. Because it was formed after the enactment of the National Environmental Protection Act, its licensing activities require NEPA compliance. For purposes of research and development flights, this places a burden on developers not experienced by experimental aircraft designers or, for that matter, by any other researchers. AST licensing does not distinguish between R&D flights and operational flights, but should. In fact, in my very first testimony before this Subcommittee, I advocated a class of license analogous to an Experimental Aircraft Certificate that would cover any number of flights confined to a certain performance envelope. Both the industry and AST have failed to follow through on that concept, but both recognize the need. Furthermore, AST has indicated that it will in fact grant such multi-flight licenses.

Whether authority can be granted to AST to apply the grandfathered principles of experimental aircraft development to relieve the unnecessary burden of NEPA compliance is not something I am qualified to judge. In last week's RLV Working Group meeting, the developers and AST discussed this at length. The consensus was that statutory relief is unlikely, and that the only solution is likely to be a categorical exclusion resulting from a string of granted licenses all of which have environmental Findings of No Significant Impact associated with them. There is no doubt that this will be the outcome, since no activity associated with RLV development has ever resulted in anything else. I note it here only to lament that there is one intractable drawback to AST licensing, one that is not of AST's making. I do not regard that one drawback as sufficient justification to place the future of the RLV industry in anyone else's hands.

From the discussion of licensing and its purpose, the question of indemnification can be addressed. Since AST space flight licensing requires demonstration of safety of uninvolved parties and their property, it is not unreasonable to ask the govern-

ment to indemnify those flights. In fact, if there is one thing I have learned it is that the *only* test of seriousness is the willingness of people to put up money. If the government issues a launch license, that license only has meaning if the government is willing to share the burden of the consequences of an accident. If the government is not willing to do so, the licensing activity is meaningless, burdensome showmanship.

By the arguments given above, this means that if the government does nothing *more* than ensuring the safety of uninvolved parties and their property, it does not bear the burden of indemnification for paying passengers on an RLV. The real question comes down to responsible risk taking. Is it responsible of the government to risk the taxpayers' money to indemnify an industry when the government does not have a certain degree of oversight, or are there factors beyond that risk which justify it?

In my opinion, there are two factors which justify the risk. First, the same licensing process that ensures the safety of uninvolved parties and their property will in fact reduce the risk of loss of life in an RLV accident. The degree of care needed just to get to an RLV flight is very high, and there is little doubt that AST will require the exercise of even more care for a passenger vehicle if only because it will be a large vehicle. Second, the charter of the government to promote the industry, with all of its potential economic benefits, justifies some risk. Once again, it is a test of seriousness.

There is an aspect of indemnification that is often overlooked, however, and that is reasonableness of the magnitude of the maximum probable loss. Though I do not have current figures at my disposal, the last number I recall for third-party launch liability insurance was $900 million. Whether we are talking about expendable or reusable launch vehicles, each has to demonstrate a probability of less than one in 30 million casualties per flight in order to receive an AST license. This automatically constrains flights to sparsely populated areas. An accident affects only a small portion of those areas, yet any reasonable appraisal would show that the *entire* area isn't worth $900 million.

Like so many things associated with space flight, the unreasonably high limits of loss are the result of a very human trait. When faced with an unknown of any kind, human beings automatically assign an unquantified, but arbitrarily high risk to that unknown. Only after acquiring knowledge based on experience do people begin to place risk in the proper hierarchical order. The first part is what has kept us from extinction. The second is what allows progress. Unfortunately, the placing of risk in proper hierarchical order is sometimes either very slow to come, or never happens at all. In those cases, progress either lags or ceases.

In the Western world, there has never been a case of a third-party human fatality due to a launch accident. The only property damage of which I am aware has been the loss of a cow to a V–2 that strayed into Mexico, and the top of a camper sheared off by the wing of an X–15 as it made an emergency landing approach that came too low over a highway (the latter is the one instance of third-party property damage caused by an RLV).

These do not add up to $900 million.

I support indemnification of the RLV industry when it comes to third-party life and property loss, simply because the government will not permit RLV flights unless they meet third-party safety requirements. I support indemnification with respect to passenger flights, primarily because the risks are mitigated by the licensing process. It is with less enthusiasm that I support this indemnification as a means of promoting the industry, but the risk to the government is fairly small. What I would suggest is a re-examination of just how much exposure there is. I do not believe that it is close to the magnitude we have always thought, and a realistic assessment may make the government more comfortable in assuming this contingent liability.

The final issue to be addressed is where the regulatory body for human passenger space transportation should be located. I have already stated my position that I believe AST to still be the regulatory office of choice, and will maintain that position as long as AST fulfills its charter. Another question is whether AST should be part of the FAA, or moved to another place.

This is a question I've wrestled with for years, and the answer is never as clear cut as I would like. There are definite advantages for AST to reside within FAA. The latter has the entire National Air Space under its jurisdiction, and perhaps the biggest practical concern in space flight is coordination with the NAS. Here the lives and property at stake are of a large magnitude, but FAA has the infrastructure to permit space flights to coexist with the NAS. This coordination extends to foreign countries. Replicating the mechanisms already in place would be horrendously inefficient, if it were even possible.

However, there is also the cultural issue to consider. FAA's culture is geared toward a technological status quo which makes for unparallel safety in aviation, but which is absolutely incompatible with the needs of an industry whose technologies are yet to be defined. Large organizations can and generally do taint smaller ones. I am amazed at the degree of autonomy and cultural identity AST has managed to maintain. I have also observed the cost of that maintenance. There has been no small amount of energy spent on territorial matters that serve no one's interests in the long run.

I think the right solution is to leave AST in FAA, with one powerful proviso: when it comes to matters of commercial space flight, the Associate Administrator for Commercial Space Transportation has the last word. Much controversy could be avoided, and uncertainty removed, if such a mandate existed. To quote one of the developers with whom I discussed this matter, the Associate Administrator "must have a bazooka" to ensure that AST is allowed to fulfill its charter. Given the vast resources available to AST within the FAA, however, it should remain there.

The concept of AST as a "clean sheet of paper" organization that could grow with an emerging industry is what I supported from the beginning. There have been many setbacks for the industry in the intervening years, and AST has occasionally gotten ahead of itself and the industry in its rule-making zeal. But as far as interactions among organizations of people go, the AST/industry relationship has been remarkably good.

I see no *fundamental* flaws, and nothing that cannot be corrected. Yes, there are problems, if one regards the inevitable disputes of an industry with a regulatory body as problematic. Where an activity of AST does not contribute to the end of ensuring the safety of uninvolved parties and their property, it should be changed—and given AST's past performance, I do not foresee any resistance to this. I would suggest mandating periodic zero-base review and rework of rules in order to ensure that the AST process does not fossilize.

What I would not like to see, and what I think is to no one's benefit, is a change from a regulatory organization that has achieved a substantial degree of understanding of the industry it is regulating to one whose regulatory approach is incompatible with that industry.

I think that, overall, we are on the right track with AST. It has the charter and the spirit to safely promote the emerging RLV industry, including the passenger RLV industry. The *Commercial Space Act of 2003* will play a large, positive part in seeing that industry come into being.

BIOGRAPHY FOR MICHAEL S. KELLY

PROFESSIONAL SUMMARY:

Mr. Kelly is launch systems engineer with over twenty three years of experience in ballistic missile propulsion systems and reusable space launch systems design. Experienced manager and technical lead of multiple system development projects.

MAJOR ACCOMPLISHMENTS:

- Founded a technology development and systems engineering and integration company.
- Patented and demonstrated a tow-launched technique for space launch vehicles.
- Headed successful effort at establishing FAA licensing regulations amenable to the existence of an entrepreneurial Reusable Launch Vehicle industry.
- Invented and demonstrated an economical thermochemical process and business model for large-scale conversion of organic waste to natural gas.
- Led a 100-man systems engineering team, which produced a patented modular solid propellant launch vehicle.

EDUCATION:

MS, Mechanical Engineering, Perdue University, 1983

BS, Mechanical Engineering, Perdue University, 1978

SECURITY CLEARANCE: SECRET/June 2003

Member, Commercial Space Transportation Advisory Committee (COMSTAC)

Chairman, COMSTAC RLV Working Group

Chief Scientist, Law Offices of Mark Cantrell, Space Law Consultants

NORTHROP-GRUMMAN XONTECH EXPERIENCE:

Technical Manager, Riverside, CA; June 2003 to Present

As Technical Manager, supported the Northrop-Grumman Targets and Countermeasures proposal to MDA. Capture manager for the development of identified business opportunities. Member of the Commercial Space Transportation Advisory Committee (COMSTAC), Chairman of the COMSTAC Reusable Launch Vehicles Working Group.

WORK EXPERIENCE SUMMARY:

Kelly Space & Technology, Inc., Chairman and Chief Executive Officer, 1993 to July 2003

Founded KST, a technology development and system engineering and integration company. Assisted MoD/BAe in marketing both Polaris A–3 TK R and its associated Chevalin equipment module to Army MICOM for targets work. Patented tow-launch technique for space launch vehicles. Orchestrated the program that demonstrated towed flight of large, manned supersonic vehicle, using Air Force and NASA assets, at Dryden Flight Research Center. Received contract from Motorola for launch of 20 Iridium satellites. Incorporation of tow-launch into NASA Space Launch Architecture defined by KST under NRA 8–27. Invented and demonstrated a high-performance, low-cost, non-toxic monopropellant having industrial as well as rocket applications. Invented and demonstrated economical thermochemical process and business model for large-scale conversion of organic waste into natural gas.

TRW, Inc., Staff Engineer, Engineering Mechanics Laboratory, 1992–1993

Identified and developed new business opportunities for TRW in System Engineering Support for commercial and governmental launch services projects. Initiated and completed several proposals to Japan Broadcasting Company for technical oversight on BS–3N launch program, and to DARPA on launch pad gas dynamics studies in support of the Taurus Program. Prepared the Launch Services segment of the TRW Strategic Plan. Initiated a large IR&D program aimed at giving the USAF a more cost-effective option for Spacelifter.

TRW Launch Services Organization, Director of Engineering, 1990–1992

Invented and patented modular solid propellant launch vehicle. Led a 100-man system engineering team in development of the concept for application to Iridium, MLV–III, and various other spacecraft programs. The concept eventually flew in the form of the Athena.

TRW Ballistic Missiles Division, Missile Technology Laboratory, Staff Engineer, 1989–1990

Provided general engineering and business development consultation to TRW and its customers on a wide range of ballistic missile and commercial space launch vehicle initiatives.

TRW Ballistic Missiles Division, Fluid Mechanics Section, Propulsion & Ordnance Engineering, Section Head, 1984–1989

Supervised a general analytical and hardware development Section supporting the Peacekeeper and Small ICBM programs. Work involved all aspects of the airborne portion of weapon system development except for the re-entry vehicle. Led the writing of the Post Boost Vehicle specification. Gained a significant amount of experience in governmental procurement practices as a member of the proposal evaluation board for the Small ICBM Assembly, Test & System Support and Post Boost Vehicle source selections. Helped identify the cause of the Small ICBM Flight Test Missile 1 failure, leading to redesign of the Stage I nozzle, and new diagnostic techniques for visualizing solid rocket motor interior ballistics. Managed an IR&D program which successfully developed CFD codes to predict unsteady loads on nozzles during hot-flyout stage separation. Performed foreign threat special studies. Performed SE/TA function for Evader Replica Penetration Aids propulsion system development. Performed engineering support functions for Re-entry Systems Launch Program (not to be confused with "Rocket Systems Launch Program") under ABRES. Assisted MoD/British Aerospace in determining reuse options for Polaris A–3 TK R boosters.

TRW Ballistic Missiles Division, Propulsion & Ordnance Engineering, Stage Development Engineer, 1982–1984

Lead propulsion engineer for the Peacekeeper missile's Stage IV, participating in all aspects of development, from component design and test through stage and Weapon System Flight Proof Design Review and Critical Design Review. Shepherded Flight Test Missile (FTM) 1 through processing and flight. Performed "quick-

look" flight data evaluation, prepared and delivered immediate briefing to the BMO Commander for FTM–1 through 18. Lead engineer for development of the new Stage IV surface tension propellant tank, and participated in zero-G testing of the tank aboard the NASA KC–135. Discovered Stage IV regulator failure in FTM–5 data, a component design flaw that was subsequently corrected. Correctly identified the location of the problem for the FTM–15 Stage IV before the end of flight; led the tiger team to find the failure mechanism; personally found the exact cause of the failure through review of the Stage build records. Wrote the Missile Compliance Matrix for the Peacekeeper booster at Weapon System Critical Design Review, clearing the missile for production.

TRW Ballistic Missiles Division, Propulsion & Ordnance Engineering, Member of Technical Staff, 1980–1982

Mr. Kelly began his career providing basic engineering review in support of the development of the Peacekeeper ICBM's Stage IV.

Chairman ROHRABACHER. Thank you very much, Mr. Kelly.

Our third witness is Raymond Duffy, a Senior Vice President of—at Willis InSpace Insurance Underwriters. So we have the insurance industry here to give us their perspective. And we appreciate your testimony. You may proceed.

STATEMENT OF MR. RAYMOND F. DUFFY, JR., SENIOR VICE PRESIDENT, WILLIS InSPACE INSURANCE UNDERWRITERS

Mr. DUFFY. Thank you, Mr. Chairman.

Actually, I am a broker, not an underwriter, but I place the insurance with insurance companies, so I am a little bit different.

Thank you——

Chairman ROHRABACHER. Thank you for that correction.

Mr. DUFFY. Thank you very much, Mr. Chairman.

I am pleased to have the opportunity today to discuss some of the issues concerning H.R. 3245. And I plan on responding to the Committee's questions as outlined in the invitation letter, but will primarily be responding to question number two regarding government indemnification for commercial human flight. As my resume indicates, the area of professional expertise in which I concentrate is directly involved with the insurance coverages that would respond to any launch vehicle failure.

The first question: "Should the Government regulate commercial human space flight?" I believe that the Government should regulate human space flight. Public policy objectives of encouraging development of the industry, protecting third parties, and protecting passengers are all important, but I believe that the regulations should focus primarily on flight safety issues. Prior experience for any new launch vehicle has shown us that most failures occur during their first three flights. Poor results for any new launch program will have a detrimental effect, not only on that particular vehicle, but also on all future commercial human space flight. Rigorous concern for flight safety issues would help assure the public that all is being done, even in the unfortunate event of a launch or flight failure. This concern would also have a very positive effect in the insurance underwriters' decisions as they reviewed the insurability of the risk.

Second: "Should the Government offer indemnification for commercial human space flight, and if so, against what sorts of liability?" The second part of that: "How should any indemnification relate to existing policies and international treaties?"

The Government offer of indemnification should not be extended to commercial human space flight. The current indemnification protection provided to the commercial space industry is unique to commercial industries in the U.S. and critical to the success of it. The inclusion of government indemnification to commercial human space flight would potentially dilute the effectiveness of the indemnification and possibly jeopardize the availability of it.

The commercial space industry is suffering from a significant downturn. This downturn is the result of a number of factors, including the economy, manufacturing defects, and to a significant degree, the technology transfer regulations that have been imposed by the Government. The international competition offers similar, if not superior, liability risk sharing protection to that offered by the U.S. Any loss or negative development of the availability of indemnification to the commercial space industry would only have the result of further damaging its position as world leader.

The current license requirements for a commercial launch under the CSLA require liability insurance to be purchased up to the maximum probable loss for the launch site as established by the Government. This indemnification would only be used in the event that the loss exceeds this. The required insurance is available at reasonable cost and would also be available for commercial human space flight licensees as well. The severity of a launch failure for a commercial human space flight would most likely be significantly less than a commercial space flight due to the size of the launch vehicle and the location of the launch. The cost of the insurance excess of the maximum probable loss would be expensive at first, but I believe it would be available. The cost of this excess would drop following successful experience of the flight vehicle.

Although the loss of a commercial human space flight would not likely be as severe as a commercial launch vehicle failure because new vehicles have a high failure rate, the potential frequency of loss is significant. If a FAA license for a commercial human space flight mission was provided with the CSLA indemnification, the frequency of loss, even without the severity, could erode the availability of the indemnification for the commercial space industry. Historically, government contracts have paid for research and development of new launch vehicles and absorbed the new launch risk. By the time commercial launches take place, the vehicle's bugs have been worked out. If the indemnification was provided to commercial human space flight without the Government's involvement during this initial period, this would also increase the degree of risk being covered and erode the availability of the indemnification for the commercial space industry.

At this point, I believe an understanding of the workings of the aviation insurance industry would also be helpful. Generally, an aviation underwriter writes all lines of aviation insurance: airlines, product liability, general aviation, and in some cases, space. The annual—the aviation industry's insurance premium is less than one percent of the annual casualty premium worldwide. The total annual premium for launch liability is less than $20 million. If there were a launch liability loss greater than that, the loss would be paid from all the supporting lines of business. Depending on the severity of the loss, payment may even end up coming from the

non-aviation property and casualty lines. A high frequency of loss in this area would quite likely affect the availability of coverage for it, just as such a frequency could affect the availability of indemnification in the future. The potential lack of indemnification in insurance following poor experience along with strict regulations could all work toward the development of a safer commercial human space flight program.

Regarding passenger liability, I do not believe that there should be any passenger liability protection provided by the Government. Except for instances of gross negligence or willful misconduct, passengers should assume this risk. It would not be appropriate for the Government to extend any protection to these people. If someone is willing to participate in commercial human space flight at this stage of its development, then the risk should be dealt with solely between the passenger and the launch provider. It is unlikely there would be any commercial insurance available responding to this risk.

The second part of the question regarding the current risk-sharing financial regime that is in place regarding treaties, what we have in place is sufficient right now, as indicated in the Risk Management Working Group's Report to COMSTAC in October of '02.

The third question: "What changes would you recommend to H.R. 3245? In particular, do you support commercial human space flight being regulated by the OCST at the FAA?" I would recommend that the bill transfer the regulation of sub-orbital human space flight from the FAA Office of the Associate Administrator for Commercial, excuse me, Space Transportation to the FAA, the AVR. As I have indicated previously, safety concerns for the vehicles would be paramount. The AVR has considerable experience in this area and would be more suited to promulgate the appropriate regulations.

Thank you.

[The prepared statement of Mr. Duffy follows:]

PREPARED STATEMENT OF RAYMOND F. DUFFY, JR.

Mr. Chairman, distinguished Committee Members and Staff:

I'm pleased to have the opportunity today to discuss some of the issues concerning H.R. 3245, the *Commercial Space Act of 2003.*

I will respond to the Committee's questions as outlined in the invitation letter, but will primarily be responding to question #2 regarding government indemnification for commercial human flight. As my resume indicates, the area of professional expertise in which I concentrate is directly involved with the insurance coverages that would respond to any launch vehicle failure.

1. Should the government regulate commercial human space flight? If so, what should the public policy objectives (e.g., encouraging development of the industry, protecting third parties, protecting passengers, etc.) of that regulation be and how should they be balanced?

Government should regulate human space flight. Public policy objectives of encouraging development of the industry, protecting third parties and protecting passengers are all important, but I believe that regulations should focus primarily on flight safety issues. Prior experience for any new launch vehicle has shown us that most failures occur during the first three flights. Poor results for any new launch program will have a detrimental effect not only on that particular vehicle but also on all future commercial human space flight. Rigorous concern for flight safety issues would help assure the public that all was being done even in the unfortunate event of a launch or flight failure. This concern would also have a very positive ef-

fect on the insurance underwriters' decisions as they reviewed the insurability of the risk.

2. Should the government offer indemnification for commercial human space flight, and if so, against what sorts of liability? How should any indemnification relate to existing policies and international treaties?

The government offer of indemnification should not be extended to commercial human space flight. The current indemnification protection provided to the commercial space industry is unique to commercial industries in the US and critical to the success of it. The inclusion of government indemnification to commercial space flight would potentially dilute the effectiveness of the indemnification and possibly jeopardize the availability of it in the future.

The commercial space industry is suffering from a significant downturn. This downturn is the result of a number of factors, including the economy, manufacturing defects, and to a significant degree the technology transfer regulations that have been imposed by the government. The international competition offers similar, if not superior liability risk sharing protection, to that offered by the U.S. Any loss of or negative development of the availability of indemnification to the commercial space industry would only have the result of further damaging its position as world leader.

The current license requirements for a commercial launch under the CSLA require liability insurance to be purchased up to the maximum probable loss for the launch site as established by the government. This indemnification would only be used in the event of a loss that exceeds this. The required insurance is available at reasonable costs and would also be available for commercial human space flight licenses as well. The severity of a launch failure for a commercial human space flight would most likely be significantly less than a commercial space launch due to size of the launch vehicle and the location of the launch. The cost for insurance excess of the maximum probable loss would be expensive at first, but I believe it would be available. The cost of this excess would drop following successful experience of the flight vehicle.

Although the loss of a commercial human space flight would not likely be as severe as a commercial launch vehicle failure, because new launch vehicles have a high failure rate the potential frequency of loss is significant. If a FAA license for a commercial human space flight mission was provided with the CSLA indemnification, the frequency of loss even without severity could erode the availability of the indemnification for the commercial space industry. Historically government contracts have paid for the research and development of new launch vehicles and absorbed the new launch risk. By the time commercial launches take place, the vehicle's bugs have been worked out. If the indemnification was provided to commercial human space without the government's involvement during this initial period this would also increase the degree of risk being covered and erode the availability of the indemnification for the commercial space industry.

At this point I believe an understanding of the workings of the aviation insurance industry would be helpful. Generally, an aviation underwriter writes all lines of aviation insurance for airlines, product liability, general-aviation, and in some cases space. The aviation insurance industry's annual premium is less than one percent of the annual casualty premium. The total annual premium for launch liability is less than $20 million. If there were a launch liability loss greater than that, the loss would be paid from all the supporting lines of business mentioned. Depending on the severity of the loss, payment may even end up coming from the non-aviation property and casualty lines. A high frequency of losses in this area would quite likely affect the availability of coverage for it, just as such a frequency could effect the availability of indemnification in the future. The potential lack of indemnification and insurance following poor experience along with strict regulations could all work towards the development of a safer commercial human space flight program.

I do not believe that there should be any passenger liability protection provided by the government. Except for instances of gross negligence or willful misconduct the passengers should assume this risk. It would not be appropriate for the government to extend any protection to these people. If someone is willing to participate in commercial human space flight at this stage of its development than the risk should be dealt with solely between the passenger and the launch provider. It is unlikely there would be any commercial insurance available to respond to this risk.

As indicated in the Risk Management Working Group Report to COMSTAC on October 31, 2002, "the current risk-sharing regime assigns financial responsibility for the most probable third-party damages arising from U.S. based launches and those conducted by U.S. commercial entities to the launch licensee whose insurance protects the interests of the U.S. government as an additional insured. Accordingly,

under the existing liability risk-sharing regime, the government is afforded financial protection in meeting certain of its international treaty obligations, up to the maximum probable loss, at no cost to the government (or the U.S. taxpayer)." This would be the same case for the commercial human space flight industry if the same approach were followed regardless as to whether indemnification is provided.

3. What changes would you recommend to H.R. 3245? In particular do support commercial human space flight being regulated by the Office of Commercial Space Transportation at the Federal Aviation Administration? If not, where and in what manner would you propose to regulate commercial human space flight?

I would recommend that the bill transfer the regulation of sub-orbital human space flight vehicles from the FAA office of the associate administrator for Commercial Space Transportation (AST) to the FAA Regulation and Certification Group (AVR). As I've indicated previously, safety concerns for the vehicles should be paramount. The AVR has considerable experience in this area and would be more suited to promulgate the appropriate regulations.

Chairman ROHRABACHER. Thank you very much.

Our fourth witness is Dr. Henry Hertzfeld, a senior research staff scientist at the Space Policy Institute Center for International Science and Technology Policy at George Washington University. Dr. Hertzfeld, you may proceed. And thank you very much for being with us.

STATEMENT OF DR. HENRY R. HERTZFELD, SENIOR RESEARCH SCIENTIST, ELLIOT SCHOOL OF INTERNATIONAL AFFAIRS, GEORGE WASHINGTON UNIVERSITY

Dr. HERTZFELD. Thank you, Mr. Chairman, Members of the Subcommittee.

Government supervision and regulation of all space flight is mandatory. The Congress has an obligation to ensure that commercial space flight is as safe as possible for all parties involved and that innocent parties, both domestically and internationally, are protected. Virtually all space activities are global, and by treaty, each nation is responsible for the actions of their citizens in space. And it is simply common sense in today's security and defense environment that the advanced technological capabilities needed to get to space will require government knowledge and supervision of those activities, whether they be for government or commercial purposes. Finally, one must travel through air space to get to outer space, which will require close coordination, but not necessarily integration, with the existing regulations for aviation.

Only recently has the prospect of commercial human space flight been seriously proposed. This could develop into new business opportunities in the coming years. The risks of commercial space flight are two-fold: financial for investors and injury to people and property. In order to encourage commercial activity, the Government should be as neutral as possible to investors in new space activities, neither subsidizing them nor adding new financial regulations to the actual investment.

Up to now, most commercial space activity has included a significant amount of government use, mainly communications and remote sensing satellites, which provides at least some excuse for continuing government indemnification liability.

However, a purely commercial human space flight, whether suborbital or in-orbital, has no dual-use purpose. Its market will be adventure-seekers or sightseers, and private investors will incur the profits or losses. The private company has a business interest and

an obligation to cover all potential liabilities as would be prudent for any profit-oriented enterprise in any industry.

Therefore, the U.S. Government should have no obligation to subsidize this type of commercial activity and should incur no financial risks from the activities of U.S. citizens involved in commercial human space travel.

This means that the current form of indemnification for space activities as enumerated by the FAA in its regulations will have to be changed. The types of changes I propose would shift the entire liability for commercial human sub-orbital and in-orbit activity to the firm. Although the cost of insurance might discourage some from entering this industry, this cost is only a relatively small fraction of the total cost of a launch and would be included in the price of the launch. Those incurring the risk should be willing to pay for the risk, particularly where there is no direct Government benefit from the activity.

H.R. 3245, as it is now drafted, may establish several other bad precedents. It perpetuates the conflict within the FAA/AST of being both a promoter and a regulator of the industry. It takes a piecemeal approach to regulation by focusing on commercial human space activities rather than considering the entire spectrum of future aviation, sub-orbital, and orbital commercial activities in a comprehensive and cohesive framework. And it proposes a definition of space and aviation activity that fails to adequately separate regulatory functions and jurisdiction.

Currently, the Office of Commercial Space Transportation at the FAA has a dual role of promoting the ELVs and RLVs as well as regulating them. Regulations by their very nature may counter promotional activities. I believe the time has come to separate these activities.

And there is another serious conflict brewing within the FAA regulatory environment itself. The history of the development of space is very different from that of aviation. The legal structure of the two sectors is also very different. Even though one has to fly through air to get to space, the same companies build both aircraft and spacecraft, and the Government R&D structure in aerospace is focused primarily in one agency, that does not mean that the two activities are the same and should be regulated by the same agency.

H.R. 3245 only addresses commercial human space flight. Other new developments that will affect both aviation and space include: high altitude platforms that may have functions that compete with low-Earth orbit satellites, unmanned aircraft, space launches that use airplanes for the first stages, et cetera. Also, by separating commercial human space activities from the transportation of cargo into sub-orbital and orbital locations, different regulations could emerge for virtually identical physical launches. The borders between aviation and space and the regulatory framework will become fuzzy.

In fact, the potential of using high altitudes, those higher than current commercial airplanes use but lower than entering orbit, for purposes other than transporting people or cargo from one point on Earth to another is an area that has great commercial and security implications and potential. Regulations currently are not well for-

mulated about the commercial use of those altitudes. I would recommend the Congress study the entire spectrum of space supervision and regulatory options.

One option that could be considered would be to establish an independent regulatory agency for space activities, something on the model of the Nuclear Regulatory Commission or the Federal Communications Commission. This would separate the promotion of commercial activity from its regulation and the problems of air versus space regulation could be coordinated through actions of two relatively equal and independently separate organizations.

The, as yet, unsolved problem of what should be classified under aviation and what should be space for regulatory actions has always been a contentious situation with many proposals, but no solutions. H.R. 3245 addresses this issue by using a definition that has now been prepared by the FAA—now been proposed by the FAA in a proposed rule making issued just a couple of weeks ago. Previous attempts at definitions have focused on either a physical description of where space begins or on a functional approach. The physical definition is very imprecise. The functional approach is one that is most commonly used where if an activity is meant to reach outer space, it is regulated as a space activity, even if it never reaches space. If it is not destined for outer space, then it is regulated under aviation regulations, where appropriate.

The proposed definition is still not the solution to the problem. One issue involves regulating the payload, the ultimate reason for the launch. Will a definition of space that is based on the vehicle lead to unintended increased jurisdiction over payloads as well? Another issue is the situation where a commercial firm could be required to obtain both an aviation certificate and a space launch license.

In conclusion, until the reliability of space vehicles improves greatly, it is clear that the commercial space launch industry is not mature nor is it similar enough to commercial aviation aircraft to be part of the aviation regulatory regime. At some future time, it is possible that aviation systems and space systems can be handled together. The time is yet to come, and by forcing round pegs into square holes at this juncture, the Congress could be inhibiting both human and non-human commercial space development rather than encouraging it.

Thank you.

[The prepared statement of Dr. Hertzfeld follows:]

PREPARED STATEMENT OF HENRY R. HERTZFELD

Government supervision and regulation of all space flight is mandatory. The Congress has an obligation to insure that commercial space flight is as safe as possible for all parties involved and that innocent parties both domestically and internationally are protected. Virtually all space activities are global. By treaty, each nation is responsible for the actions of their citizens in space. And, it is simply common sense in today's security and defense environment that the advanced technological capabilities needed to get to space will require government knowledge and supervision of those activities, whether they be for governmental or for commercial purposes. Finally, one must travel through air space to get to outer space, which will require close coordination, but not necessarily integration, with the existing regulations for aviation.

Only recently has the prospect of commercial human space flight been seriously proposed. This could develop into a new business opportunity in the coming years. In order to encourage commercial activity, the Government should be neutral as

possible to investors in new space activities—neither subsidizing them nor adding new financial regulations to the actual investment. The risks of commercial space flight are two-fold: financial for investors and injury to people and property. The Government does have an obligation to insure that commercial space companies fully protect non-participants and government property while maintaining some basic standards for the safety of its employees and customers.

Up to now most commercial space activity has included a significant amount of government use (mainly communications and remote sensing satellites), which provides at least some excuse for a continuing government indemnification liability.

However, purely commercial human space flight, whether sub-orbital or in-orbit has no dual-use purpose. Its market will be adventure-seekers or sightseers and private investors will incur the profits or losses. The private company has a business interest and an obligation to cover all potential liabilities as would be prudent for any profit-oriented enterprise in any industry.

Therefore, the U.S. Government should have no obligation to subsidize this type of commercial activity and should incur no financial risks from the activities of U.S. citizens involved in commercial human space travel.

This means that the current form of indemnification for space activities as enumerated by the FAA in its regulations on financial responsibility will have to be changed. At present, the FAA determines the maximum probable exposure for third-party liability from a commercial launch activity and requires the private company to indemnify that activity up to that amount (which can be as high as $500 million per flight). Between that figure and a cap of $1.5 billion, the U.S. Government is obligated to pay for third party damage. Above the cap, the payment options are not specified. The types of changes I propose would shift the entire liability for commercial human sub-orbital and in-orbit activity to the firm. Although the cost of insurance might discourage some from entering this industry, this cost is only a relatively small fraction of the total cost of a launch and would be included in the price of a launch. Those incurring the risk should be willing to pay for the risk, particularly where there is no direct Government benefit from the activity.

H.R. 3245, as it is now drafted, may establish several bad precedents. It perpetuates the conflict within the FAA/AST of being both a promoter and regulator of the industry. It takes a piecemeal approach to regulation by focusing on commercial human space activities rather than considering the entire spectrum of future aviation, sub-orbital, and orbital commercial activities in a comprehensive and cohesive framework. And it proposes a definition of space and aviation activity that fails to adequately separate regulatory functions and jurisdiction.

Currently the Office of Commercial Space Transportation at the FAA has a dual role of promoting the ELV (and RLV) industry as well as regulating it. Regulations by their very nature may counter promotional activities. As commercial space activities expand (e.g., commercial human sub-orbital and eventually possible orbital flights), these two roles become even more difficult to accomplish within the same Office than before. I believe the time has come to separate these activities. Promotion of U.S. industry has traditionally been the province of the U.S. Department of Commerce. If the DOT/FAA is to regulate space without conflict, the promotional activities should be transferred elsewhere.

And, there is another serious conflict brewing within the FAA regulatory environment itself. The history of the development of space is very different from that of aviation. The legal structure of the two sectors is also very different. Even though one must fly through air to get to space, the same companies build both aircraft and spacecraft, and the Government R&D structure in aerospace is focused in one agency, that does not mean that the two activities are the same and should be regulated by the same agency. As it now stands, different offices within the FAA must compete for regulatory authority. As commercial space matures, the conflicts will become much greater. This is wasteful, and will lead to sub-optimal solutions for the aviation industry, for the space industry, and for U.S. competitiveness internationally.

H.R. 3245 only addresses commercial human space flight. Other new developments that will affect both aviation and space include: high altitude platforms that may have functions that compete with low Earth orbit satellites, unmanned aircraft, space launches that use airplanes for first stages, etc. Also, by separating commercial human space activities from the transportation of cargo into sub-orbital and orbital locations, different regulations could emerge for virtually identical physical launches. The borders between aviation and space and the regulatory framework will become fuzzy.

In fact, the potential of using high altitudes (those higher than current commercial airplanes use, but lower than entering orbit) for purposes other than transporting people from one point on Earth to another is an area that has great com-

mercial (and security) potential. Regulations currently are not well formulated about the commercial use of these altitudes. It appears that the uses of these altitudes will be functionally and competitively closer to space uses than aviation, but the means of getting there may be more like aircraft than spacecraft. As this activity develops, the question of where and how it should be regulated is open to debate. Because commercial human space activity is only one part of this debate, setting precedents now for the regulation of these activities in a piecemeal fashion may create disincentives and confusion for other near-term innovative commercial activities in this region of the atmosphere. I would recommend that the Congress study the entire spectrum of space supervision and regulation options.

One option that the Congress might consider would be to establish an independent regulatory agency for space activities on the model of the FCC or the NRC. This would separate the promotion of commercial space from its regulation. And the problems of air vs. space regulation could be coordinated through actions of two equally independent and separate organizations. This would eliminate wasteful turf wars within an agency and would not prematurely force space regulations into aviation regulation, which, as it is now formulated, is not the appropriate model for space activities.

The as yet unresolved problem of what should classified under aviation and what should be space for regulatory actions has always been a contentious situation with many proposals but no solutions. H.R. 3245 addresses this issue by using a definition that has now been proposed by the FAA in a proposed rule-making in the *Federal Register* (Vol. 68, No. 202, October 20, 2003). Previous attempts at definitions have focused on either a physical description of where space begins or on a functional approach. The physical definition is imprecise. The functional approach is the one most commonly used where if an activity is meant to reach outer space it is regulated as a space activity (even if it never reaches space). If it is not destined for outer space, then it is regulated under aviation regulations, where appropriate.

The proposed definition is still not the solution to the problem. Other problems and issues are raised by the construction of a definition based on the design of the vehicle involved. One issue involves regulating the payload—the ultimate reason for the launch. Currently the FAA reviews each payload for safety. Will a definition of space that is based on the vehicle lead to unintended increased jurisdiction over payloads as well? Another issue is the situation where a commercial firm could be required to obtain both an aviation certification *and* a space launch license. This likely will be expensive and time consuming. It is also counter to the intent of Congress to create a simpler, more commercially friendly regulatory regime that *encourages* firms to engage in innovative space and aviation activities and *encourages* future financial commitments from both entrepreneurs and from the investment community.

In conclusion, until the reliability of space vehicles improves greatly, it is clear that the commercial space launch industry is not mature nor is it similar enough to commercial aircraft to be part of the aviation regulatory regime. The current FAA space launch licensing regime is oriented toward issuing a license for each space mission (i.e., launch), while in the aviation world a Certification of Flight Worthiness certifies that a particular vehicle is safe to fly commercially. By creating an independent space regulatory agency that could include authority over commercial human space activity as well as high altitude activities (at least those that are not related to transporting humans from one point to another on Earth), the pressures to move too quickly toward integration with aviation regulation would be eased.

At some future time it is possible that aviation systems and space systems can be handled together. That time is yet to come, and by forcing round pegs into square holes at this juncture, the Congress could be inhibiting both human and non-human commercial space development rather than encouraging it.

BIOGRAPHY FOR HENRY R. HERTZFELD

Dr. Henry R. Hertzfeld, Senior Research Scientist at the Space Policy Institute, George Washington University, is an expert in the economic, legal, and policy issues of space and advanced technological development. He has served as a Senior Economist and Policy Analyst at both NASA and the National Science Foundation, and has been a consultant to many agencies and organizations. He is the co-editor of *Space Economics* (AIAA 1992), as well as many articles on space economic and legal issues. Dr. Hertzfeld holds a B.A. from the University of Pennsylvania, a M.A. from Washington University, and a Ph.D. degree in economics from Temple University. He also has a J.D. degree from the George Washington University and is a member of the Bar in Pennsylvania and the District of Columbia.

Chairman ROHRABACHER. My, my, we do have different points of view here, don't we? And I see that the great thing about being on that side is you can give your opinions but in the end, the guys on this side have to make up the final decision. And sometimes it is not 90/10. Sometimes it is 45/55. But for most of the laws that we have to deal with, it is 45/55. So——

Mr. WU. Yes, but Mr. Chairman, if I may interject, we may make some legislative decisions, but some of the folks out there actually wind up building the stuff, so that——

Chairman ROHRABACHER. All right.

Mr. WU [continuing]. Proves its own challenge.

Chairman ROHRABACHER. All right.

Well, we appreciate all of you, and we have one final witness: Pamela Meredith, who is counsel at the law firm of Zuckert, Scoutt & Rasenberger, LLP, where she practices aerospace and space law. Ms. Meredith also is an adjunct professor of Satellite Communications and Space Law at American University's Washington College of Law. Thank you very much for being with us today, Ms. Meredith. And you may proceed.

STATEMENT OF MS. PAMELA L. MEREDITH, COUNSEL, ZUCKERT, SCOUTT & RASENBERGER, LLP

Ms. MEREDITH. Thank you very much, Mr. Chairman and Members of the Subcommittee.

I suppose there is a reason why you put Gary Hudson and me on opposite sides of the table here. Thank you for inviting me to speak on this very important subject of commercial human space flight and the regulation of it and, in particular, H.R. 3245.

I commend the Committee for taking these early steps to lay the legal foundation for the development of a commercial human space flight industry.

Let me say that I am here today speaking in my own personal capacity, and I do not represent my firm or any clients of the firm. And the views I express here are entirely my own.

I have submitted testimony for the record, and this, what I am doing here now is summarizing the points of that testimony.

Commercial human space flight should be regulated by the Government. The Commercial Space Launch Act, which this committee was instrumental in creating, provides a good framework for that regulation with a few modifications. The FAA's Space Office is the appropriate regulator for commercial human space flight. There are some revisions required for the Commercial Space Launch Act to be appropriate for regulating human space flight. And those revisions need to accomplish the four following objectives: one is to make clear that the FAA's Space Office has the authority to license human space flight; the second is create or establish protection, safety protection, that is, reasonable safety protection for passengers and crew; and establish reasonable liability and insurance protection for passengers and crew; and finally to regulate only to the extent necessary. Those are the four objectives that need to be achieved by revisions of the Commercial Space Launch Act.

Now looking at your bill H.R. 3245, the purpose of that bill, the stated purpose of that bill, is the opening of outer space to the

American people. And to truly accomplish that goal, the bill needs to meet the four objectives I just outlined.

The bill does make clear that the FAA's Space Office has the authority to license human space flight. The bill creates a safety regime where the entire safety focus is on the general public to the exclusion of passengers and crew. In other words, with the exception of medical standards and a requirement for training, the FAA's Space Office would be examining—would not be examining the passengers' safety on board the vehicle, but rather the innocent bystanders, the third parties, the innocent bystanders that may be injured in a launch accident. Now is that the kind of safety regime that promotes the bill's goal of opening up space to the American people? I am just posing the question.

As far as liability is concerned, the bill provides for assumption of risk by passengers and crew. The bill provides for the passenger to assume the risks inherent in human space flight. It appears that the bill will require the passenger to waive its rights to claim against the launch company and its contractors and subcontractors in the event the passenger is injured. It is a little bit unclear how the bill is going to accomplish that goal. There are some things in the bill that need to be clarified, but that seems to be the thrust of it.

Also, the passenger could be held liable to third parties who are injured on the ground, those are the innocent bystanders, in the event of a launch accident. In such a case, the passenger would not be protected by the launch company's liability insurance. That liability insurance would protect the launch company and the launch company's contractors and subcontractors but would not protect the passengers the way the bill is structured. Also the way the bill is structured, the passenger would not have the benefit of the government indemnification, which again protects the launch company and other launch participants for any damage or any liability above the insured amount. One can pose the question: In essence, the passenger gets the worst of all worlds; is this the kind of legal regime that promotes the goal of opening space to the American people?

[The prepared statement of Ms. Meredith follows:]

PREPARED STATEMENT OF PAMELA L. MEREDITH

1. Should the government regulate human space flight? If so, what should the public policy objectives (e.g., encouraging development of the industry, protecting third parties, protecting passengers, etc.) of that regulation be and how should they be balanced?

Summary Answer: The government should regulate commercial human space flight. The Commercial Space Launch Act of 1984, as amended and recodified[1] ("CSLA"), provides an appropriate general framework for the regulation of human space flight. Some revision of the act is desirable to clarify that the CSLA applies to human space flight and necessary to establish reasonable safety and liability regimes for human space flight.

Current Regulation of Commercial Space Transportation

The Department of Transportation, and by delegation the Federal Aviation Administration's Associate Administrator for Commercial Space Transportation ("FAA/

[1] Title 49, Transportation, Subtitle IX, Commercial Space Transportation, Chapter 701, Commercial Space Launch Activities, 49 U.S.C. §§ 70101–70121.

AST"),[2] licenses and regulates launches and re-entries[3] under the CSLA.[4] The FAA/AST licenses and regulates launches and re-entries "[c]onsistent with the public health and safety, safety of property, and national security and foreign policy interests of the United States.. . ."[5]

Initially, the FAA/AST's authority applied only to launch operations. The authority was extended by a 1998 amendment to the CSLA to include re-entry operations.[6] The purpose of the amendment was to "establish a statutory framework for the licensing of commercial re-entry activities.. . ."[7] Prior to the adoption of that amendment, this committee noted: "Currently, there is no licensing procedure to conduct re-entry from space. Such re-entry is vital if new technologies in reusable launch vehicles are to be exploited and the opportunity to conduct commercial experiments in space for return to Earth is to be taken."[8]

It is not entirely clear that the FAA/AST's licensing authority under the CSLA extends to human space flight. There is no explicit mention or clear embrace of humans, whether crew or passengers, in the CSLA. At the same time, there is no prohibition on the licensing of humans. The FAA/AST appears to have taken the position that it has the authority to license human space flight.[9]

A license under the CSLA is required "to launch a launch vehicle. . .or to re-enter a re-entry vehicle."[10] Launch means "to place or try to place a launch vehicle or re-entry vehicle and any payload from Earth (A) in a sub-orbital trajectory; (B) in Earth orbit in outer space; or (C) otherwise in outer space.. . ."[11] A "payload" means "an object that a person undertakes to place in outer space by means of a launch vehicle or re-entry vehicle.. . ."[12] While the term "payload" does not include humans, the definition of "launch" does not preclude humans.

The Need to Regulate Commercial Human Space Flight

There are at least two reasons why the government should, or would want to, regulate commercial human space flight. First, the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies[13] ("Outer Space Treaty"), to which the United States is a party, provides that States "bear international responsibility for national activities in outer space, including the Moon and other celestial bodies, whether such activi-

---

[2] *See* 49 C.F.R. § 1.47(v) (providing that the Federal Aviation Administrator "is delegated authority to. . .[c]arry out the functions vested in the Secretary by 49 U.S.C. Subtitle IX"); *see also* 50 Fed. Reg. 9036 (Mar. 6, 1985) (delegating authority under the CSLA to the Director of the Office of Commercial Space Transportation) and 60 Fed. Reg. 62762 (Dec. 7, 1995) (transferring the Director of Commercial Space Transportation's CSLA authority to the FAA Administrator).

[3] A license is required to "launch a launch vehicle" or "re-enter a re-entry vehicle." 49 U.S.C. § 70104(a)(1). A launch vehicle is "(A) a vehicle built to operate in, or place a payload in, outer space; and (B) a sub-orbital rocket." *Id.* § 70102(7). A re-entry vehicle is "a vehicle designed to return from Earth orbit or outer space to Earth, or a reusable launch vehicle designed to return from Earth orbit or outer space to Earth, substantially intact." *Id.* § 70102(14).

[4] The FAA/AST's licensing and regulatory authority extends to: 1) launches/re-entries in the U.S.; 2) launches/re-entries by U.S. persons or entities anywhere in the world; 3) launches/re-entries by U.S. controlled foreign entities on the high seas or from international air space, unless there is an agreement that a foreign government will license the launch/re-entry; and 4) launches/re-entries of U.S. controlled foreign entities in foreign countries if there is an agreement that the U.S. will license the launch or re-entry. 49 U.S.C. § 70104(a). The FAA/AST also licenses and regulates launch sites and re-entry sites. *Id.*

[5] *Id.* § 70105(a)(1).

[6] Commercial Space Act of 1998, Pub. Law 105–303, § 102, 112 Stat. 2843, 2846–2851 (1998).

[7] Commercial Space Act of 1997, H.R. Rep. No. 105–347, at 20.

[8] Civilian Space Authorization Act, Fiscal Years 1998 and 1999, H.R. Rep. No. 105–65, at 23. The Committee pointed out that the FAA/AST had previously taken the position that "a re-entry [was] subject to a launch license requirement on the grounds that re-entry entailed the placing of a launch vehicle in a sub-orbital trajectory 'from Earth orbit [and that the FAA/AST had] since abandoned that position.. . ." *Id.,* at 60; *see also* Commercial Space Act of 1997, H.R. Rep. No. 105–347, at 21 (providing the same).

[9] *See, e.g.,* Financial Responsibility Requirements for Licensed Re-entry Activities, Notice of Proposed Rule-making ("NPRM"), 64 Fed. Reg. 54448, 54457 (Oct. 6, 1999) (providing that "[w]ith the development of RLV technology comes the possibility of crewed or piloted launch vehicles whose operations would be subject to FAA licensing"). In the same NPRM, the FAA solicited comments on the subject of a "regulatory program that would. . .address passenger safety." *Id.*

[10] 49 U.S.C. § 70104(a).

[11] *Id.* § 70102(3).

[12] *Id.* § 70102(9).

[13] Outer Space Treaty, *done* Jan. 27, 1967, 18 U.S.T. 2410.

ties are carried on by governmental agencies or by non-governmental entities.. . ."[14]

The "activities of non-governmental entities. . .shall require authorization and continuing supervision.. . ."[15] The treaty does not distinguish between manned and unmanned flight. The treaty does not specify the kind or degree of regulation required; rather it leaves that to each State party to decide with respect to its national space activities.

Second, there are public policy reasons for regulating commercial human space flight. The government has an interest in ensuring that such flight is consistent with fundamental public policy objectives, such as public safety, national security, and foreign policy interests of the United States. This Committee made note of precisely these public policy concerns when adopting the CSLA:

> Government supervision over the activities of private parties who provide commercial launch services must be exerted to safeguard life and property, to prevent actions that would jeopardize national security and foreign policy, and to ensure that U.S. treaty obligations, such as those in the Outer Space Treaty, are met.[16]

While it may be clear that some government regulation of commercial human space flight is in order, questions remain as to *when to regulate; how to regulate; and how much to regulate.* The answer to the first question depends on the state of the commercial human space flight industry. In other words, how imminent is commercial human space flight? The issue of how and how much to regulate depends to a large extent on the policy objectives the government seeks to achieve. It also depends on the general philosophy and approach to regulation of high technology commercial endeavors.

Public Policy Objectives of Commercial Human Space Flight Regulation

The policy objectives of the CSLA are to: 1) "promote economic growth and entrepreneurial activity through the use of the space environment. . .;" 2) "encourage the United States private sector to provide launch vehicles, re-entry vehicles, and associated services. . .;" and 3) provide for licensing and regulation of launches and reentries consistent with "the public health and safety, safety of property, and national security and foreign policy interests of the United States."[17]

These policy objectives also support human space flight. To accomplish these objectives with respect to human space flight, the following key ingredients of human space flight regulation should be considered:

- *A clear articulation of the FAA/AST's authority to license and regulate commercial human space flight.* Private sector initiatives are generally encouraged by regulatory certainty and discouraged by regulatory uncertainty.
- *Reasonable safety protection of passengers and crew.* The FAA/AST has interpreted its public health and safety mandate under the CSLA as directed at the public at large, and not extending to launch service participants, e.g., launch site personnel. The question is whether the FAA's safety mandate should extend at least to passengers in order to establish reasonable safety protection. A regime with virtually no safety oversight of passengers may not be sustainable if the goal truly is to promote an industry of public space travel.
- *Reasonable qualification criteria for crew and passengers.* Given the high-risk nature of space flight at this stage of industry development, qualification criteria may be advisable for both crew and passengers. The FAA already imposes certain qualification requirements on ground-based launch safety personnel, which may be applied or adapted for crew. Qualification criteria for passengers should be designed to ensure a minimum level of safety for the passenger, while not being so burdensome as to discourage human space flight.
- *Reasonable liability and insurance protection for passengers and crew.* The liability regime for passengers should be compatible with the current CSLA provisions for commercial space transportation, which have worked well. At the same time, the regime must offer the necessary liability and insurance protection to promote commercial human space flight. The current regime, as

[14] *Id.*, art. VI.
[15] *Id.*
[16] Commercial Space Launch Act, H.R. Rep. No. 98–816, at 8.
[17] 49 U.S.C. § 70105(b)(1)–(3).

set forth in the CSLA, has three major components: 1) cross waivers; 2) third party liability insurance; and 3) indemnification:

- The CSLA requires the licensee to enter into cross waivers of liability with its customers whereby each party agrees not to sue the other and to assume responsibility for loss or damage it sustains and for injury, loss or damage sustained by its employees.[18] The licensee and customer must each extend these waivers to their respective contractors and subcontractors involved in launch/re-entry services requiring them not to sue the other party or the other party's contractors and subcontractors.[19]
- The CSLA requires the licensee to obtain third party liability insurance in an amount stipulated by the FAA/AST.[20] This insurance must protect not only the licensee, but also the United States, the licensee's contractors and subcontractors and the customer, as well as the contractors and subcontractors of the customer.[21]
- The CSLA provides that indemnification is available against third party claims above the insured amount, subject to certain conditions.[22] See question 2, below.

Should a passenger be required to sign a liability waiver by which it relinquishes its rights to sue the licensee and other launch participants assuming the passenger is injured?[23] The benefit of such a waiver would be that the passenger could not get sued by the licensee or other launch participants. Currently, launch customers, which are required to sign waivers, protect themselves through insurance. Is it reasonable to expect passengers to take out life insurance? Would such insurance even be available (at a reasonable price) for a risky activity such as space flight? Or should the licensee be required to indemnify the passenger through limited "carrier" liability?

Should crew members be required to sign liability waivers? Assuming crew members are the employees of the licensee, such employees are not now required to sign waivers. While the employees are not full beneficiaries of the waivers, they are afforded some protection.[24] Precisely how far this protection extends and whether it would be adequate is not entirely clear.

Should passengers be considered third parties and, thus, beneficiaries of the licensee's third party liability insurance in the event of an accident resulting in passenger injury or death? If not, should the passenger be protected as an additional insured from claims by third parties? Should the passengers be entitled to CSLA indemnification? Or should the licensee be required to indemnify the passenger through limited "carrier" liability?

The same questions apply to the crew. Assuming crew are employees of the licensee, the FAA/AST does not consider them third parties.[25]

- *Minimal regulation.* Private industry is best served by minimal regulation, i.e., regulation only as necessary to serve essential public policy objectives. This is especially true for evolving high technology industries, such as, space transportation. Excessive regulation can stifle technological development. The technology should drive the regulation, not vice versa. The CSLA espouses this approach. It provides that launch and re-entry should be regulated *"only to the extent necessary.* . .to ensure compliance with international obligations

[18] *Id.* § 70112(b); 14 C.F.R. § 440.17 and Part 440, Appx. B, Agreement for Waiver of Claims and Assumption of Responsibility ("Waiver Agreement"). The purpose of the cross waivers is: "(1) to limit the total universe of claims that might arise as a result of a launch; and (2) to eliminate the necessity for all these parties to obtain property and casualty insurance to protect against these claims." Commercial Space Launch Act Amendments of 1988, S. Rep. No. 100–593 (1988), at 14.

[19] 14 C.F.R. § 440.17(b); Waiver Agreement, *supra* note 18, § 4.

[20] 49 U.S.C. § 70112(a).

[21] *Id.* § 70112(b).

[22] *See infra* notes 37–39 and accompanying text (describing indemnification under the CSLA).

[23] *See Martin Marietta Corp. v. International Telecomm. Satellite Org.,* 991 F.2d 94, 100 (4th Cir. 1992) (providing that "neither the language of the [CSLA] Amendments nor their legislative history reflects a Congressional intent to protect parties from liability for their own gross negligence").

[24] For example, the customer agrees to hold such employees harmless from any liability arising out of claims from customer's contractors and subcontractors. Waiver Agreement, *supra* note 18, § 5(b).

[25] Compare the FAA's definition of "third party" in 14 C.F.R. § 440.3(a)(15)(ii) (providing specifically that U.S. government personnel are third parties).

of the United States and to protect the public health and safety, safety of property, and national security and foreign policy interests of the United States."[26]

2. *Should the government offer indemnification for commercial human space flight, and if so, against what sorts of liability? How should any indemnification relate to existing policies and international treaties?*

Summary Answer: There appears to be no reason to treat a human space flight differently than unmanned flight as far as indemnification of the licensee and its contractors, subcontractors, and customers and the customers' contractors and subcontractors are concerned. However, whether the passenger and crew should be entitled to indemnification depends on the broader liability regime selected for these individuals.

International Treaty Obligations

The United States may be held internationally liability for damage caused by launch vehicles or their payloads, or the component parts of launch vehicles or payloads, under certain conditions. This liability is imposed by the Outer Space Treaty[27] and the Convention on International Liability for Damage Caused by Space Objects[28] ("Liability Convention") and general principles of international law.

The Liability Convention provides that a launching state is "absolutely liable to pay compensation for damage caused by its space object on the surface of the Earth or to aircraft in flight."[29] Absolute liability means that it is not necessary to prove fault. "In the event of damage being caused elsewhere than on the surface of the Earth to a space object of one launching State or to persons or property on board such a space object by a space object of another launching State," liability is based on fault.[30]

Liability rests with the "launching state," which is defined as the State "which launches or procures the launching of a space object [or a] State from whose territory or facility a space object is launched."[31]

Liability under the Outer Space Treaty and the Liability Convention applies to the United States, as a party to these treaties. The treaties do not impose liability directly on private companies, such as launch companies and their contractors or customer. Nor do they impose liability directly on private individuals, such as crew or passengers. On the other hand, the United States may be held liable under the treaties for the activities of these entities and individuals because the United States bears "international responsibility" under the Outer Space Treaty for national activities in space.[32]

Needless to say, the Outer Space Treaty and Liability Convention are not the only sources of liability for the licensee and its contractors, subcontractors and customers, or for passengers. These parties could also be held liable under private tort law, even for damage in a foreign country.[33]

Current Indemnification Regime for Commercial Space Transportation

The CSLA requires that a launch or re-entry licensee obtain third party liability insurance (or demonstrate financial responsibility) to compensate claims from third parties for the "maximum probable loss."[34] The FAA/AST determines the amount of insurance required.[35] That amount shall not exceed $500 million.[36] In practice the FAA/AST requires considerably less. The amount varies from launch vehicle to launch vehicle.

---

[26] 49 U.S.C. § 70101(a)(7). (Emphasis added).

[27] Under the Outer Space Treaty, "[e]ach State Party to the Treaty that launches or procures the launching of an object into outer space [or] from whose territory or facility an object is launched, is internationally liable for damage to another State Party by such object or its component parts.. . ." Outer Space Treaty, art. VII.

[28] Liability Convention, *done* Mar. 29, 1972, 24 U.S.T. 2389.

[29] *Id.,* art. II.

[30] *Id.,* art. III.

[31] *Id.,* art. I(c).

[32] *See supra* note 14 (setting forth the international responsibility of the United States for its national activities in space pursuant to the Outer Space Treaty, art. VI).

[33] *See* Liability Convention, art. XI.2 (providing that "[n]othing in this Convention shall prevent a State, or natural or juridical persons it might represent, from pursuing a claim in the courts or administrative tribunals or agencies of a launching State").

[34] 49 U.S.C. § 70112(a)(1)(A).

[35] *Id.* § 70112(a)(2).

[36] *Id.* §§ 70112(a)(3)(A)(i).

The CSLA provides for indemnification for claims above the insured amount, subject to certain conditions. Adopted as part of the 1988 Amendments to the CSLA, the indemnification provision allows:

> To the extent provided in advance in an appropriation law or to the extent additional legislative authority is enacted providing for paying claims. . .the Secretary of Transportation shall provide for the payment by the United States Government of a successful claim. . .of a third party. . .resulting from an activity carried out under the license.. . .[37]

The limit of the indemnification is $1.5 billion above the insurance amount.[38] The indemnification is available for claims of a third party against the licensee or a contractor, subcontractor or customer of the licensee, as well as a contractor or subcontractor of the licensee's customer.[39]

The rationale behind the indemnification was that there was not sufficient commercial insurance available at a reasonable price to protect against third party liability resulting from a catastrophic launch accident. Congress reasoned that "[t]he potential unlimited liability that the commercial launch industry faces from third party claims is a deterrent to the development of a domestic commercial [launch] industry."[40] Congress stated:

> Commercial operators cannot be expected to provide hundreds of millions of dollars in liability self-insurance to gain a license to operate launch vehicles. Nor can domestic commercial operators be expected to pay exorbitant premiums which would eliminate any possible profit from these operations or make their services noncompetitive with foreign launch services.[41]

The indemnification was intended to be temporary, that is, "to facilitate the transition of the Nation's launch industry from a Government activity to a commercial activity."[42] A sunset provision in the CSLA provides that the indemnification expires unless the request is received by December 31, 2004.[43] The proposed legislation, H.R. 3245, provides for a three year extension of the indemnification,[44] a short horizon given the long lead time involved in space projects.

Government Indemnification for Commercial Human Space Flight

The question of whether the Government should indemnify human space flight is twofold. First, the question is whether the current indemnification regime should distinguish between manned and unmanned flight in terms of providing indemnification in favor of the types of parties that currently benefit from the indemnification. These parties include the licensee and its customer and their respective contractors and subcontractors. There does not appear to be a reason to distinguish, as the rationale that supports indemnification of unmanned flights applies equally to manned flights.

Second, the question is also whether passengers should benefit from the indemnification, assuming they may be liable to third parties for any damage they cause. The answer to this question depends on the broader liability regime selected for them. If they are required to sign waivers, and if they are considered non-third parties and additional insureds under the licensee's third party liability insurance, it may be reasonable to extend the indemnification to them. On the other hand, if they are considered third parties that may sue the licensee and its contractors and subcontractors, or if they are otherwise indemnified through some type of "carrier" liability, it may not make sense to also extend the indemnification to them.

3. What changes would you recommend to H.R. 3245? In particular, do you support commercial human space flight being regulated by the Office of Commercial Space Transportation at the Federal Aviation Administration? If not, where and in what manner would you propose to regulate commercial human space flight?

Summary Answer: I would recommend: 1) Careful consideration of the possible implications of extending the FAA/AST's authority to human space flight through an amendment of CSLA definition of "payload;" 2) Careful consideration of whether the proposed safety regime for passengers is adequate to achieve H.R. 3245's goal of

---

[37] *Id.* § 70113(a)(1).
[38] *Id.* § 70113(a)(1)(B).
[39] *Id.* § 70113(a)(1).
[40] Commercial Space Launch Act Amendments of 1988, S. Rep. No. 100–593 (1988), at 17.
[41] *Id.,* at 11.
[42] *Id.,* at 22.
[43] 49 U.S.C. § 70113(f).
[44] H.R. 3245, § 5. A Senate bill provides for an extension of the indemnification provision to December 31, 2009. S. 1260, § 3.

opening outer space to the American people; and 3) Clarification of the liability regime established by H.R. 3245 and consideration of whether it is adequate to achieve the bill's goal.

The Objectives of H.R. 3245

The articulated goal of H.R. 3245 is "the opening of outer space to the American people and their economic, scientific, and cultural enterprises is a priority goal which should guide Federal Space investments, policy development, and regulatory action."[45] To achieve this goal, H.R. 3245 should, at a minimum, accomplish these objectives: 1) clarify the FAA/AST's authority to license human space flight; 2) provide reasonable safety protection for passengers and crew; 3) impose a reasonable liability regime on passengers and crew; and 4) regulate only to the extent necessary.

Licensing Authority for Commercial Human Space Flight

H.R. 3245 attempts to clarify that the FAA/AST has the authority to license commercial human space flight under the CSLA. The bill does so by amending the definition of "payload" to include an "individual," and not just an "object," as is currently the case. As noted above, the CSLA authorizes the FAA/AST to license the launch of a launch vehicle or re-enter a re-entry vehicle and any payload.[46] The new definition makes passengers and crew a payload.[47]

The implication of including crew and passengers as payloads is that the FAA/AST has so-called "payload determination" authority over crew and passengers under the CSLA. That means that the FAA/AST has the authority to "prevent the launch or re-entry [of these individuals] if [the FAA/AST] decides the launch or re-entry would jeopardize the public health and safety, safety of property, or national security or foreign policy interests of the United States."[48] It will be necessary to carefully consider other potential consequences of including "individuals" in the definition of "payload."

Safety Protection for Passengers and Crew

H.R. 3245 takes the position that Federal regulation of human space flight "should focus on protecting the safety of the general, uninvolved public, while allowing involved persons to assume risks which are inherent to human space flight activities."[49] In other words, H.R. 3245 provides that the FAA/AST's public health and safety mandate be directed at the general public, to the exclusion of passengers and crew. Accordingly, the FAA/AST's "payload determination" as to whether the launch would "jeopardize public health and safety" presumably would focus on whether the passenger/crew poses a hazard to the public at large, and not whether the space flight would be safe for the passenger or crew.

H.R. 3245 does temper this *laissez-faire* safety treatment to some extent by imposing qualification requirements on passengers, designed to protect their safety, such as medical standards and a requirement for training. The question is whether this safety regime is sustainable. In other words, is this minimalist approach to safety regulation adequate to promote the bill's goal of opening outer space to the American people?

Liability Regime for Passengers and Crew

Again, H.R. 3245 takes the position that federal regulation of human space flight should "allow[ ] involved persons [presumably passengers] to assume risks which are inherent to human space flight activities."[50] The first question is whether the bill as now styled achieves that objective. A separate question is whether such a li-

---

[45] H.R. 3245, § 2(3).

[46] *See supra* note 3 (providing that the FAA has the authority to license the launch of a launch vehicle and the re-entry of a re-entry vehicle).

[47] H.R. 3245 does not define "individual," but makes it implicitly clear that the term encompasses both crew and passengers, which the bill calls "space flight participants." The bill defines crew as "an individual or individuals carried within a launch or re-entry vehicle who performs a function necessary for the protection of public safety." H.R. 3245, § 3(c)(2). A space flight participant means "an individual who is not crew carried within a launch or re-entry vehicle during a launch or re-entry." *Id.*, § 3(c)(4).

[48] 49 U.S.C. § 70104(c). The FAA has this authority for payloads that are not otherwise subject to U.S. government licensing or authorization. 14 C.F.R. §§ 415.51.

[49] H.R. 3245, § 2(6); *see also id.*, § 4 (providing that the focus of commercial human space flight regulation should be on "protecting the safety of the general public, while allowing space flight participants who have been trained and meet license-specific standards to assume an informed level of risk").

[50] H.R. 3245, § 2(6).

ability regime is sustainable and whether it promotes the goals H.R. 3245 is trying to accomplish.

The liability treatment of passengers and crew in the bill is incongruous. H.R. 3245 treats passengers and crew as non-third parties, while at the same time depriving them of the protections afforded to other non-third party participants in launch and re-entry services. H.R. 3245 amends the CSLA definition of "third party" to make clear that "crew and passengers" are not third parties. These individuals are added to a list of non-third parties, which includes the licensee, the customer and their respective contractors and subcontractors. Yet, crew and passengers do not benefit from the protection as additional insureds under the licensee's third party liability insurance, as do, e.g., the licensee's contractors, subcontractors, and customer. Passengers and crew also do not benefit from the CSLA indemnification.

It is not clear whether passengers or crew will have to sign the CSLA liability waiver. The waiver applies to the licensee and its "customers" and their contractors and subcontractors that are "involved in launch services." Are passengers and/or crew "customers?" The FAA defines customer as "the person who procures launch services. . .,"[51] which is true of a passenger, but not crew. It would be a stretch to apply the remaining portion of the "customer" definition—providing that "any person who has placed property on board the payload" is a customer—to crew.

Even assuming passengers meet the definition of "customer," are passengers "involved in launch services?" The waiver applies only to parties "involved in launch services." Furthermore, H.R. 3245's addition of "passengers" to a list of non-third parties that already contains "customers" suggests that passengers are not considered customers for purposes of the liability waiver under the bill. If the bill's intention was to extend the waiver to customers, that purpose may not have been achieved.

BIOGRAPHY FOR PAMELA L. MEREDITH

Title: Co-Chair, Space Law Practice Group

Practice Areas: Commercial Space Contracts, Administrative Law, Insurance, Policy and Legislation

Education: Persbråten Gymnasium (Artium, 1975); University of Oslo School of Law (J.D. equivalent, 1981); McGill University, Air & Space Law Institute (LL.M., 1983)

Pamela L. Meredith advises clients on commercial space project planning, implementation, risk management, and contract dispute resolution issues. She has written numerous articles and a textbook on related topics and is a frequent speaker at satellite communications and space law conferences in the U.S. and internationally.

Ms. Meredith is also an Adjunct Professor of Satellite Communications and Space Law at American University's law school in Washington, D.C.—a course she started in 1989.

As part of her space law practice, Ms. Meredith drafts and negotiates commercial and U.S. government space contracts, including launch contracts, satellite manufacturing contracts, transponder lease agreements, and contracts for supply of spacecraft components and launch vehicle subsystems. She represents both U.S. and foreign companies and a foreign government.

Ms. Meredith advises on space project risk management and space insurance issues, including policy wording, coverage disputes, and insurance defense. Ms. Meredith also has testified as an expert witness for insurers in commercial space contract litigation.

Ms. Meredith advises on U.S. government export licensing and regulatory matters. She helps obtain licenses and approvals from the U.S. State Department. These include DSP–5 and DSP–83 licenses and approvals for Technical Assistance Agreements, Manufacturing Licensing Agreements, and retransfers of technology.

Ms. Meredith assists in obtaining launch licenses from the Federal Aviation Administration (FAA) and advises on FAA regulatory issues, including rule-makings. She also monitors Congressional legislative developments that may impact FAA launch licensing and regulation.

Ms. Meredith assists in obtaining licenses and other approvals for communications satellite services before the Federal Communications Commission (FCC). Ms. Meredith has assisted or advised on some aspect of most of the FCC rule-making

[51] 14 C.F.R. § 440(a)(3).

proceedings for communications satellites in the 1980s and 1990s, including fixed satellite service (C-, Ku-, Ka- and V-bands) and mobile satellite service (geostationary, big LEO and little LEO). She has also testified as an expert witness in litigation concerning the interpretation of FCC regulations.

Ms. Meredith is a Member of the District of Columbia and New York bars. She chairs the American Institute of Aeronautics and Astronautics' (AIAA) Legal Aspects Committee.

Select Publications:

Textbook:

Space Law: A Case Study for the Practitioner: *Implementing a Telecommunications Satellite Business Concept* (Martinus Nijhoff, 1992). (384 pages, co-authored: P.L. Meredith & G.S. Robinson).

Articles:

American Journal of International Law, 1984, "The Legality of a High Technology Missile Defense System: The ABM and the Outer Space Treaties."

National Legal Center for the Public Interest, 1986, "Domestic Commercialization of Space: The Current Political Atmosphere." (Co-authored).

Nordic Journal of International Law, 1986, "The Legality of Launch Vehicle Passage Through Foreign Airspace."

Proceedings of the XXXII Colloquium on the Law of Outer Space, 1989, "A Comparative Analysis of United States Domestic Licensing Regimes for Private Commercial Space Activities."

Journal of Space Law, 1989, "Status of the 'Patents in Space' Legislation in Congress."

Proceedings of the XXXIII Colloquium on the Law of Outer Space, 1990, "Implementing a Telecommunications Satellite Business Concept: Overview and Relative Timing of Legal Actions."

California Western Law Review, 1990, "Privately-Owned Commercial Telecommunications Satellites: Licensing and Regulation by the Federal Communications Commission."

The American University Journal of International Law and Policy, 1991, "Legal Implementation of Space Debris Mitigation Measures."

Proceedings of the XXXIV Colloquium on the Law of Outer Space, 1991, "Risk Allocation Provisions in Commercial Launch Contracts."

The Air and Space Lawyer, 1992, "Implementing a Telecommunications Satellite Business Concept: The Necessary Legal Steps."

Proceedings of the XXXV Colloquium on the Law of Outer Space, 1992, "Spacecraft Motion Management (SMM): Institutional and Legal Frameworks."

Cambridge University Press, 1994, "A Legal Regime for Orbital Debris: Elements of a Multilateral Treaty."

Proceedings of the XXXVII Colloquium on the Law of Outer Space, 1994, "Damage Caused by Orbital Debris to a Commercial Satellite: Liability Issues Raised by a Hypothetical Case Scenario."

Satellite Finance, 1998, "Financing a Communications Satellite Venture: Assessing the Regulatory Risk" (with Rachel B. Trinder).

Journal of Space Law, 1999, "Space Technology Exports: The Current Political Climate" (with Sean P. Fleming).

DISCUSSION

PASSENGER INDEMNIFICATION

Chairman ROHRABACHER. Thank you very much for your testimony. And all of the witnesses, you have our appreciation.

We now will proceed with questions. And as Chairman, I will kick them off. I would like to—the point you just made, Ms. Meredith, about passengers and their indemnification, so a passenger, as you see it now, would be in need of indemnification for not being held responsible for a crash? Is this true with a passenger on an airplane today or would it be true of a passenger in something else?

Ms. MEREDITH. Well, you know, Mr. Chairman, I have got to be careful here. I am here talking about space law and not aviation law. It is not my expertise, so I can't really tell you about aviation liability. But all I am saying is if the goal of the bill is to promote the opening of space to the American people, we have to be careful that we don't create a regime that allows only the super wealthy to take advantage of the opportunity because others will not be able to put in place the insurance they will need to cover themselves to go up on a space ride.

Chairman ROHRABACHER. Well, I understand. The whole issue of indemnification, I understand that I—it was not something that I thought of as being something that had anything to do with passengers. And maybe someone—is there anyone else on the panel—maybe Mr. Duffy knows this answer, do we need—Ms. Meredith suggests that we need to make sure that the—we specifically state that the passengers have indemnification, are not liable for damages caused if the vehicle crashes. Do you see that as well?

Mr. DUFFY. Well, I don't know where this—the bill that is being proposed veers away from the CSLA, but looking at the existing CSLA, the customers are included and the definition as the insured under the launch licensee so the customers are protected the same way everybody else is. And I would allocate the customer to the passenger at that point, so——

Chairman ROHRABACHER. So do you believe that problem is taken care of? Ms. Meredith, do you——

Ms. MEREDITH. Well, I tell you what. The way the bill is structured today, it is not entirely clear that the passenger would be a customer under the Act. That is—we could go into the—I have gone into the details of that in my written testimony, but it——

Chairman ROHRABACHER. Okay. Let——

Ms. MEREDITH [continuing]. Is not entirely clear.

Chairman ROHRABACHER. Okay. Let me ask the panel, would we—for those who agree that there should be indemnification, we all agree that—you all agree that—believe indemnification, that passengers should be included in that indemnification, is that correct, for those of you who agree with indemnification? I think Mr. Hudson is opposed to that or says it is not necessary.

Mr. HUDSON. Well, I think it is not necessary, but there——

Chairman ROHRABACHER. Right.

Mr. HUDSON [continuing]. Will be indemnification anyway, because the companies will be buying it, so the customers would, in fact, be included in that policy.

Chairman ROHRABACHER. Okay. But do we—so maybe we need to make sure, as this bill proceeds, that we put something specifically into making sure there is no doubt in someone's mind, because we know if there is doubt at all, lawyers get rich off doubt, don't they? And we wouldn't want to see that happen, would we? Sorry, Bart.

So—but Mr. Kelly, did you have something to say on that?

Mr. KELLY. I—Pamela raises an excellent point. I hadn't considered the passenger, particularly a well-heeled passenger probably has more money than the launch vehicle operator——

Chairman ROHRABACHER. Mr. Tito, there you go.

Mr. KELLY. Mr. Tito may well be held liable for causing the vehicle to have been built in the first place and then riding as a passenger in it. And unless this is made clear, yes, he would be open to liability beyond what he deserves.

Chairman ROHRABACHER. Well, I think as this bill proceeds, we will take that recommendation to heart and make sure that that is crystal clear. And that is very important.

I—the idea that government license and government regulation is the trade-off, that indemnification goes with regulation and license, that is an interesting philosophical point, and I—it is not one that—I was a little—I—the Chair has been looking at indemnification as a gift bestowed upon certain people in the society, and the basic points today by the panel seems to indicate that if you are going to regulate somebody and you are going to license somebody, that person has a right to expect something in return. Indemnification is part of that. But now, of course, that doesn't—how does that work in comparison with other industries?

Mr. HUDSON. The reward, Mr. Chairman, is usually the profitability to your company or the ability to be in business if there is a——

Chairman ROHRABACHER. Right.

Mr. HUDSON [continuing]. Staked control of an industry, as in this case. In aviation, for example, there is no additional indemnification that I am aware of for, say, airline operators.

Chairman ROHRABACHER. The panel will enlighten us on that, if they——

Dr. HERTZFELD. Well, I believe there are many industries, particularly the pharmaceutical industry. They are heavily regulated, pharmaceuticals for the Food and Drug Administration, and yet they are liable for civil suits if something goes wrong.

Chairman ROHRABACHER. Right. And also—well, we also have the nuclear power industry, which is regulated, and then we give them indemnification because we—do we not? I mean, they are—very, very—my staff is indicating that there are industries, but very few industries, that get such indemnification.

Mr. DUFFY. Right, they are very—I mean, in fact, I believe the nuclear regulatory industry is primarily 85 804 indemnification that way through the government contracts and such. But to my knowledge, this is the only industry that has indemnification in excess of the required insurance unless somebody knows something——

Chairman ROHRABACHER. And there is an hour—to be fair to Ms. Meredith's point, if you are going to have indemnification of unmanned rockets and if you were going to indemnify this industry in terms of just putting cargo up, it makes no sense to have a double standard and to try to convince the industry—to make it harder for the industry to put someone—a human being as their cargo that—to have a regulatory rule here or a series of regulations that then makes it harder for the aerospace industry to actually build a rocket and launch a system that has a human being on it as compared to just cargo. That doesn't make any sense. And your analysis should have really, you know, shot out at me there, because that is logic as—until I heard you just testify, it didn't really hit home.

So we will probably have a second round, but we now go to Mr. Gordon.

GOVERNMENT RESPONSIBILITY

Mr. GORDON. Thank you, Mr. Chairman.

Just quickly following up on your—I guess your question concerning the legitimate concern that if the Federal Government does authorize a—or give a license for flight, then there is some responsibility. I would agree that there is some responsibility that goes with that. I would disagree with Mr. Kelly that thinks that it ought to be indemnification. I mean, again, we have already cited that we don't do that for airlines, we don't do it for trucking. When I get my personal driver's license, we don't. There may be a reason to do that. Indemnification, there may be a reason for us to do it, but it is not a logical jump from just because we authorized it. So—but I think we do need to give some consideration as to whether there are other legitimate reasons for indemnification.

Let me go to the idea of passenger risk. There seems to be two general feelings here. One is that there is an absolute assumption of risk. The passenger says, you know, "I know what the odds are. Here I am, you know, signing up. And let us go," versus the idea that, once again, if there is going to be some type of licensing from the Federal Government that there should be at least some general guidelines as to that. So let me ask the panel just by a raise of hands, how many of you think that it is just a complete assumption of risk for passengers? Okay. And how many of you think that the Federal Government has some responsibility to the passenger? Raise your hand. All right. So you are going both ways here?

Mr. DUFFY. Just—no, I—just a little clarification. In what capacity? In—to regulate properly? Absolutely, I believe that the Federal Government has a duty that way.

Mr. GORDON. Well, again, Mr. Chairman, I will just make an editorial comment since we are trying to put a bill together here. I certainly feel that in terms of a test pilot that is being paid that they know what they are getting into. I think that a passenger, you know, we regulate ferris wheels and, you know, all kinds of different types of equipment. I feel that there needs to be some type of a minimum responsibility. Again, there is an assumption that this is risky and it can't be beyond, you know, other than risk, but I am a little hesitant to just say, you know, "Thrill seekers, bring your millions on over and, you know, you have got a one in five chance and you can brag to all of your buddies if you make it." I think we have a little bit more responsibility than that. Where that lies, I am not sure, but if we are going to license it, we have got to have a little more responsibility.

Yes, sir, Mr. Hertzfeld?

Dr. HERTZFELD. Yes, sir. I think we—the confusion here is over whether the Government has any financial stake in the indemnification scheme. In terms——

Mr. GORDON. Indemnification, I think, is another matter. Indemnification is more third party.

Dr. HERTZFELD. Right.

Mr. GORDON. The question I posed was the paying passenger, whether or not there is an absolute assumption of risk so that the

Government would have no responsibility to set any kind of guidelines. And you seem to think that there—by a show of your hand, you said there was that absolute assumption of risk, that——

Dr. HERTZFELD. Um-hum.

Mr. GORDON [continuing]. There is no government role here for the passenger—as passenger.

Dr. HERTZFELD. There certainly could—no. There certainly could be a government role in requiring a company to have insurance to cover, for example, the third party liability issues that——

Mr. GORDON. Right. I want to talk about that, but I only——

Dr. HERTZFELD. Okay.

Mr. GORDON [continuing]. Have a short bit of time. Right now, I am focused just on the paying passenger.

Dr. HERTZFELD. Okay. The—just as the Government takes on some responsibility these days in the cigarette industry and other industries, if there is a potential liability, a potential safety risk, the Government certainly could have a role in protecting passengers that—in its licensing authority.

Mr. GORDON. So here—I mean, this really is sort of strange. You are saying that there is an absolute assumption of risk with the passenger, that the passenger takes all of the risk and that there should be no government regulation as to any level of safety, yet you are saying if the Government—if the passenger takes that absolute risk, then we ought to still have some indemnification?

Dr. HERTZFELD. No, no.

Mr. GORDON. I mean, that doesn't make any sense to me.

Dr. HERTZFELD. I am simply saying the passenger is a free agent. They can buy a ticket or not buy a ticket. If they buy a ticket, then one presumes that the company will have various levels of insurance that will apply to the passenger or the passenger themselves can purchase insurance on the flight. And that is different from whether the Government assumes any risk itself. As a condition of flying, it can require, and does require, participants to purchase insurance.

Mr. GORDON. On airlines? On buses?

Dr. HERTZFELD. Companies have liability insurance, and passengers may or may not, but the risks there are clearly different. And the risk—the third-party risks are also different there.

Mr. GORDON. So you are going to say to me, as a taxpayer, that I have got to guarantee indemnification here, but I don't have anything to say about the rules which they are going to be flying?

Dr. HERTZFELD. I am not sure that I follow the logic there, because——

Mr. GORDON. Well, that is because I am not following your logic.

Dr. HERTZFELD. Okay.

Mr. GORDON. You——

Dr. HERTZFELD. Yeah.

Mr. GORDON. Okay. Are you saying that the Federal Government should have some responsibility, not the third parties, but to the paying passenger?

Dr. HERTZFELD. Only in the most general sense to the company that you—that the company has to provide certain safety—go through certain safety requirements——

Mr. GORDON. Okay. So now you are saying that the Federal Government would set what those standards are?

Dr. HERTZFELD. Possibly, yes, minimal standards for the safety of the flight.

Mr. GORDON. Okay. So you shift—you have shifted positions then?

Dr. HERTZFELD. Slightly.

Mr. GORDON. So you are no longer the absolute—so now we have got three to two absolute take assumption of risk. Does anybody else want to—do you all three, any of you want to modify your position?

Mr. DUFFY. Just, Mr. Gordon——

Mr. GORDON. Yes.

Mr. DUFFY [continuing]. The Government would have a duty to provide regulations that would create a safe environment for the flight.

Mr. GORDON. Okay. So now we are two to three then?

Mr. DUFFY. Right. But that—there would be an assumption of risk on the passenger as far as any liability arising out of that flight, any liability through him, anything that happened arising out of that flight——

Mr. GORDON. Once there is a certain threshold——

Mr. DUFFY. The same as with an airline.

Mr. GORDON. Okay. So now we are two to three here. So you all two—the ones on the left, once again, are you still in the position that there is an absolute assumption of risk?

Mr. KELLY. Yes, there is. The Government's regulation of space launch, once again, is—requires demonstration of a level of safety to third parties and their property that automatically, if satisfied, demonstrates that—or at least mitigates the risk to a third party. H.R. 3245 requires disclosure of the safety record of an RLV to a potential passenger. Until you know—until you have experience flying these things, you can not dictate, in advance, safety standards, because there are no standards. There is nothing——

Mr. GORDON. But there is a difference between——

Mr. KELLY. No, no, no——

Mr. GORDON. You are not talking about paying passengers to be the test pilots, are you?

Mr. KELLY. In effect, that is what they are, and that is what barnstorming passengers were in the early days of aviation. There are people who do things that are very risky, and the Government——

Mr. GORDON. So——

Mr. KELLY [continuing]. Does not regulate that nor should it.

Mr. GORDON [continuing]. Is the paying passenger going to, for lack of a better term, drive the vehicle?

Mr. KELLY. No. No, no, no.

Mr. GORDON. Okay. Well, since—so then if they are not—so the barnstormers were the ones that were really testing the equipment?

Mr. KELLY. Absolutely.

Mr. GORDON. So the passengers aren't doing anything—there are no—there is no testing there, so there——

Mr. KELLY. No.

Mr. GORDON [continuing]. Is no benefit. The passenger doesn't bring any value added?

Mr. KELLY. The—other than paying for the flight. That is his benefit, and that is what will propel the industry.

Mr. GORDON. All right. I am getting ready to go a little longer, because——

Chairman ROHRABACHER. That is all right.

Mr. GORDON. So just to—so then, I guess—so we are two to three, but our two, I guess, you would say that by virtue of getting the licensing that that is where the Federal Government would come in with a certain standard level of safety?

Mr. KELLY. And they already do, yes.

Mr. GORDON. Okay. Now Mr. Hudson, would you agree with that?

Mr. HUDSON. I promise I will not change my vote. The—but let us put some temporal perspective on this. We are looking back at 100 years of aviation this year. What—where we are is looking forward at 100 years of space flight that has not yet occurred. From the time the Wright Brothers first flew to 1926, there was no regulatory authority in this Nation whatsoever, and that was the barnstorming era. That is where you could pay your $5 at a county fair and be taken up in a jenny that was surplus from World War II. And people did that. Some died. It was through that period of time until, actually, the unfortunate death of Knute Rockne, that real regulation did not occur in the commercial aviation industry. And that wasn't really seriously codified until the FARs in 1963. And we have a long period of time where we learned and where, unfortunately, people died.

There are some enterprises, adventure enterprises, for example, climbing Everest, which, if you go out as a climber, you won't even be accepted unless you have some level of training and experience. And 100 people climbed every year paying $50,000 to $100,000, and 10 percent of them die. We don't expect that kind of injury or fatality rate in future sub-orbital or orbital flight, but the possibility always exists. Those people accept that risk for some period of time, and that is why I recommended a period of, perhaps, 20 years where the risk might decline, maybe, after 10 years and you go to a new set of standards.

Mr. GORDON. But you said even the Everest folks had to get a license?

Mr. HUDSON. No, they do not, sir. They—the companies that mount the expeditions at Summit Everest will look at you and say, you know——

Mr. GORDON. Yeah, but I mean they require a certain—they don't just—it is not just—there are still certain requirements.

Mr. HUDSON. Only imposed by the companies on the participants, not by any federal agency.

Mr. GORDON. So is there any indemnification?

Mr. HUDSON. I am certain people go out and try and buy it. I don't know that you could get very much at that rate.

Mr. GORDON. All right. Thank you.

Excuse me for taking so long. I——

Chairman ROHRABACHER. No, that is all right. I—just to note that my family—I am the first Rohrabacher not to have been born

on a small farm ranch and my family—people in my family were always working people and pretty poor. And my dad always reminded me when I was a kid about the day that he saw the plane land—the barnstormer land at the carnival and how they scraped up the money and from—everybody in the family put their money together so that he could get in that plane and go up on a flight, and of course, my father later became a military officer during World War II and a pilot and stayed—and, you know, it uplifted our family. That one little experience uplifted our family beyond what our family had ever been before. And so when we are talking about these types of situations, we are talking about uplifting humankind. And if he couldn't have gone on that flight because there had been some kind of restriction that, after all, this barnstormer hadn't passed all of his tests and didn't have the money to put down on some things, then his airplane would never have landed in that carnival in the first place or if they would have said, "You know, you can go up, but if something happens to the plane, as the passenger, you are going to have to pay for the guy's cows that you run into," or something like that. It probably would have been a $10 ticket and dad never would have made it up. And well, you wouldn't have me here today. So there are pluses and minuses for all of that.

But with that said, we will go to Mr. Bell from Texas, who probably has some other homely anecdotes as well.

EFFECTS OF COST ON ACCESS TO SPACE

Mr. BELL. None to rival that, Mr. Chairman.

But I think you make an interesting point that you are—you were talking about poor people having opportunity to fly and enjoy that experience. And Ms. Meredith, I thought you made an excellent point during the course of your testimony that you would hate to see this turn into a system where only the super wealthy in our society could take advantage of it. But as this legislation is proposed, don't you think that is exactly the type of system that we would be creating?

Ms. MEREDITH. Yes——

Mr. BELL. Microphone, please.

Ms. MEREDITH. I think that is what the bill, as it is structured now, is creating, yes, with the waivers and the lack of any insurance and indemnification protection.

Mr. BELL. Does anybody disagree with Ms. Meredith's assessment?

Mr. HUDSON. Well, since I am at the other end of the table, I guess I will disagree.

Mr. BELL. You don't have to just because you are sitting there.

Mr. HUDSON. No, but it—there is history there, so we can friendly disagree on this subject. No, I think that the facts of physics are what may exclude poor individuals in the near-term from flying on sub-orbital or orbital space vehicles. Try as we might, the best engineers and the best minds of this country in aviation and space have bent their will to this, and we are still talking about ticket prices for sub-orbital flight that might be $100,000 and ticket prices going to orbit that will be several millions. We are not going to change that in the next two decades, so——

Mr. BELL. So what do you disagree with that she is saying? I mean——

Mr. HUDSON. Well, I am saying that I don't believe that you can create an egalitarian structure that allows anybody to fly just because of insurance issues or indemnification issues. I don't—I think that is in the noise of the actual cost of engaging in the activity.

THE PURPOSE OF COMMERCIAL HUMAN SPACE FLIGHT

Mr. BELL. And correct me if I am missing something, but all we are really talking about here is a way to make money, are we not? I mean, what are—I guess if there are other great purposes behind this type of commercial space flight, I would love to be educated in that regard, because it sounds like we are just opening it up for a way to pump millions into—for private individuals to—or private companies to take folks into space. Am I missing something?

Mr. KELLY. Well, one of the things that we are doing is allowing those people who have the desire and the money or the means to go into space. And the first one of these people, Dennis Tito, put up, from what I have heard, $15 million to $20 million of his own money to fulfill a lifelong dream. He couldn't do it in this country, because no one would let him, so he had to go to Russia to do it. I say that if people have the money and the desire to go into space, that if there is a means available, there is no reason why in this country they shouldn't be able to avail themselves of that means. This legislation allows them to do that.

Why there should be any concern about this initially being for wealthy people is a little puzzling to me. Every single product that comes along from the automobile to the personal computer is affordable only to very well heeled individuals to begin with. And it is only through the growth of markets and the growth of demand that the cost of things comes down. And those wealthy individuals are the ones who, through their early purchases, pay for the development of these industries and allow them to become available to everyone. So I would encourage private passenger space flight early on, just as aviation was only available to wealthy people in the early days of the airlines, so space is going to be available only to wealthy people until, as Gary pointed out, we can get a better handle on how to do it economically.

EFFECTS OF A LOSS OF A VEHICLE

Mr. BELL. Does anybody else wish to comment on that?

I guess what concerns me, though, too, is the downside that seems to be somewhat overlooked in all of this, in the case of an accident, Mr. Duffy, if you could, explain one part of your statement I—because I didn't understand this. "Although the loss of a commercial human space flight would not likely be as severe as a commercial launch vehicle failure because new launch vehicles have a high failure rate, the potential frequency of loss is significant." Are you—what are—exactly are you saying?

Mr. DUFFY. Sure. Thank you. We are talking from the concepts that I understand so far, we are talking about a relatively smaller launch vehicle than we would with, you know, the Delta IIs or Delta IVs or any of the Atlases.

Mr. BELL. Okay.

Mr. DUFFY. So severity is the amount of damage that the vehicle would do in the event of a loss, number one. And number two, and that is an important point, and I am glad you brought it up. Historically, all of the launch vehicles that we have, we use in the United States today for commercial space flight, have been subsidized by the U.S. Government military in order to get to where they are today. So all of that R&D cost, we have gone through it all. They have worked out all of the bugs. And before there is anything that goes up for a commercial launch, it has been true—tried and tested. In this environment, there isn't the money there coming from the Federal Government, so these guys are going to be trying things without that testing. So the likelihood—in my opinion, the likelihood of a loss is greater because of that. There is no R&D going on. The people themselves are going to be experiencing this, these barnstormers. So the likelihood of frequency is greater because of that.

Mr. BELL. And Mr. Chairman, I know my time is—if I could ask one other—but you are not attempting to downplay what the impact would be in case of some type of fatal accident associated with commercial space flight, are you? Don't you think that could have a rather devastating impact on the overall space program and people's view of space even though they have assumed the risk?

Mr. DUFFY. Absolutely, in fact, that is a comment I make in my statement that—but yes. I mean, initially, if—and that is why I feel that it is so important for some government involvement in the regulations so it is safe that if there is a high frequency of failure with the initial stages of human space flight that that could very seriously damage the public's outlook on it and the future of it in general.

Mr. BELL. Thank you, Mr. Chairman.

Chairman ROHRABACHER. Thank you.

We have an active Member of this subcommittee, Mr. Wu of Oregon. And you may proceed.

DETERMINING A BALANCE OF REGULATION

Mr. WU. Thank you, Mr. Chairman.

And I just want to make a couple of general comments and then toss something out for our panel's consideration and response. I think that under the Chairman's questioning and Mr. Gordon's questioning, this legislation, which I am a supporter of, and this industry, potential industry, which I am a supporter of, I would like to see both succeed, but there are clearly some significant issues of indemnification, liability, regulation that we need to work out over time. And I intend to do more homework on my own to work on some of those things and hopefully get some good counsel and advice from you all, too. It troubles me a little bit this image of putting up customers/passengers as potential test pilots. I mean, when you take someone to Disneyland, you know, you kind of think that they have run the Matterhorn a few times before they put the paying customer on the Matterhorn. And we know from Disneyland that even Disneyland isn't perfect, but you know, it has been run a few times.

So what we have here is kind of a spectrum where at one end is what the Chairman has described as the barnstorming scenario of wide open, unregulated—well, and who knows what the liability and indemnification scenarios would be. That is one end. And the other end is highly regulated, carefully worked out indemnification and so on and so forth. And you have a full spectrum here. And the challenge is we have got to work it out and get it right, because if we don't work it out and get it right, the industry won't take off. And if we get it wrong, you know, there is more risk and so on. I just want to point out that, you know, I used to be a tech lawyer and did a bunch of copyright and patent work. And I believe that for the first while, folks could get their music in the jukeboxes and not pay royalty on it, and that was to get the jukebox industry going. So there was this period from 1903 to 1926 when there was virtually no regulation of aviation. I just want to point out that we put folks into space, as I recall, around 1960, '61, or '62. So it has been 40 years, and the question is whether, you know, after four decades, maybe the physics makes this a different process but whether it is appropriate to proceed somewhere between the barnstorming scenario and the highly-regulated, carefully worked out liability scenario. And I just want to toss that out for the panel to discuss where on that continuum do you think we ought to be at this point in time and that is doable for the industry and is good public policy for the long term, because I do believe that there is an inspirational factor in letting people get into space. As the Chairman said about his father, and as—since one astronaut told me, we wouldn't let folks, civilians, get into our stuff, but you know, the Russians were a little bit more strapped so they cut a deal, and I think that was inspirational to a whole lot of folks. And there is that important function.

I want to toss that out to you all to discuss about where we should be on this continuum at this point in time.

Ms. MEREDITH. Okay.

Mr. WU. We have the two ends of the continuum right here.

Ms. MEREDITH. I guess we have two different sides of the continuum here. Okay, Gary?

Mr. HUDSON. I yield.

Ms. MEREDITH. I think you are making an excellent point, and your point is we need a balance, because we need a sustainable regime here. We don't need something that will work for a year and then we have a fatal accident and then we have to rethink it all. I think we need a balance in our safety regulation. Again, we can't just look to people outside the vehicle. We have to have some safety scrutiny of the person, the passenger that is riding on the vehicle. That is the one thing. And in the liability side, there has to be a sharing of liability. Everything can not be on the passenger, because I don't think you have a sustainable regime that way. Maybe some indemnification by the Government, some indemnification of the passenger by the launch company that limited liability, and perhaps some by the passenger. The passenger is paying the price of the ride. But there has to be a balance, and I think that is the key, finding that right balance that creates a sustainable regime.

Mr. WU. We could make it more interesting and jump to the other end and then come back across the room. Please, Mr. Hudson?

Mr. HUDSON. Thank you.

No one is suggesting at this table, I am certain, or in the industry, that we start flying passengers as test pilots. There is no suggestion of that whatsoever. All the responsible operators, and that includes everyone that is in the business at the moment, because you don't go into the business without spending millions of dollars, you are not irresponsible if you do that, there is too much visibility in your—on your actions, all responsible operators have test programs. Some have suggested as many as 1,000 flights, test flights, prior to actually carrying a paying passenger. In testimony before this—before the Joint Committee hearing last summer. Others have programs of 20, 30, 40 flights with fully qualified test pilots. Those flights are ongoing today. At least one company has flown four or five times already. So the space flight participant in the barnstorming era, which may be an unfortunate characterization of——

Mr. WU. Okay. But that one is going to stick. It is too colorful not to.

Mr. HUDSON. Indeed, and—but I don't think it is a pejorative term or a negative term, frankly. I think it is representative of where we have to be for these near-term flights where you may be flying 50 people a year or 20 people a year or 100 people a year. As we learn, those people, to a degree, are part of the experiment. They are part of the grand experiment of opening the space frontier to all of humanity for the rest of time. And if we impose upon them a regulatory structure that is as burdensome as we currently put on, say, commercial passenger aviation, that future will be closed off, at least in this country.

EXPERIMENTAL CERTIFICATION

I would finally state that the recommendation that I make with regard to experimental type certification is precisely the environment that you have to operate in. During the experimental type certification, every aircraft gets this. If Boeing goes out and builds a new triple seven, the very first one that they develop, they fill out one sheet of paper. It takes 42 minutes. And they have one FAA-designated airworthiness representative come out, look at it, stamp the piece of paper, and they fly. And they will fly 1,000 flights before they carry a revenue passenger and get full type certification.

We can do exactly the same thing with sub-orbital and orbital rockets. And as we move through that type certification process, ultimately, at some point, you reach the same level of maturity as the commercial airline industry. We will not reach it, we can not mandate it, we can not pull it out of a hat in a time scale, in my view, of less than, probably, two decades. Perhaps one decade, but that is being optimistic. It is more likely two, maybe even three. So we have to create an environment to allow people to take those risks in the near-term to make sure that Aunt Minnie can fly into orbit in 2050 to visit her grandchildren.

Mr. WU. With the indulgence of the Chairman, would any of the other panelists, Mr. Kelly, Mr. Duffy, Dr. Hertzfeld, would you like to comment or are we——

RLV VS. EELV

Mr. KELLY. Just a couple of quick comments. First, I want to differentiate between the reusable launch vehicle, which I think is an unfortunate term. I have tried to get it banned without success, but—and the space launch industry, as we know it, with expendable launch vehicles. Reusable launch vehicles are just that. As Gary said, they may fly up to 1,000 times before carrying the first revenue passenger. An expendable launch vehicle only flies once, and there is no such thing as an existing expendable launch vehicle despite the fact that satellite customers often say, "Well, I want to fly on an existing launch vehicle." There is only a design, and the vehicle itself only exists once.

That is the difference between the safety record that an RLV can achieve and what an ELV can achieve, according to Mr. Duffy. You may have failures early in flight, but if the vehicle is not destroyed, then that same vehicle will fly many, many, many times, and that vehicle will be the one that has the flight safety record. By the time you go to fly passengers, you know everything about that vehicle, at—what it does, what it is going to do, and therefore, you can make a very sound judgment as to what the risks are. And this is part of the reason that they included a flight safety record in H.R. 3245. I believe that that provision alone, along with the FAA/AST licensing requirements, are sufficient to guarantee the safety of passengers.

I do not think that you need to go beyond that, because to do so would be to place a more onerous burden, certainly a huge financial burden on the developers that would prevent them from ever getting to the point where they could carry paying passengers.

RISK

There is a final comment, and that is I have always been puzzled at the supposition that one fatal accident in the commercial reusable launch vehicle industry, fatal passenger accident, would be the end of the industry. That would separate that industry from every other activity undertaken by human beings. If there were a case—I can't think of a case where an entire activity of human beings has been shut down by one fatal accident, but that seems to be the perception. If that were the case, there would be no automobile travel, there would be no aircraft travel, there wouldn't be—you wouldn't be able to get out of bed in the morning, because everything involves risk. And to say that this industry of all activities would be shut down as the result of a single fatal accident is just, to me, not credible.

Mr. DUFFY. I will just make a couple comments quickly from the insurance perspective.

There is a required insurance that is under the CSLA for commercial launch vehicles. Underwriters understand that. And you have to remember that in the world, there are a very limited number of underwriters who participate in this kind of a risk. And to

be honest, only a couple of those underwriters who participate in it really truly understand it. It is—absurd as that may seem. There are, maybe, two or three in London, maybe one or two in the States, and that is it. And all of the other underwriters are followers. And they trust the lead underwriters on what their judgment is. So it is key that you understand that there is a very tiny number of people who really have any true understanding of how this all works.

If there was a regime in place similar to what we have for the CSLA where the launch company, the subcontractors, the Government, and the customer or passenger, whatever, were included in that program, and then the license would require that the—this program was purchased up to the maximum probable loss, that is it is under the CSLA, as determined by the Government, they figure out what is the worst probable loss for this location. What is the worst thing that can happen here? And that is the amount of insurance they have, and everybody is protected in that. Underwriters will buy that.

They won't buy it cheaply. It is—I spoke to two underwriters last week. One is the largest domestic underwriter, and the other one is—got bought by a British company, but they used to be as big as the other one. And one said, "Well, yeah, I think we could do something, but, you know, it will be expensive." And the other one say, "No way would I touch that," in the beginning. So really what we are doing is we are going over to London now and we are going to get participants over there and get those guys involved, because they are more likely to participate in something like this, especially in the initial stages. So it is not something that you can buy off of the shelf. It is something you are going to have to put together.

And secondly, the success of the industry is so critical to the availability of insurance. If you take the worldwide premium, that is the number of dollars that companies pay to the underwriters for launch liability, that is the Boeings, that is the Lockheeds, that is the orbitals here in the States, because those are the only three companies that launch. That is it. And then you have got the Russians. You have got the Chinese. You have got the Japanese and a little bit with the Australians. All of those countries, by the way, have regimes that are similar to what we have here. That total premium is less than $20 million. And they are providing limits in the area of 500. So what I mentioned in my remarks earlier is that if a loss occurs, it is going to have to come from the other sectors. It is going to come from airlines and general aviation or products liability and everywhere else. That is the only way they are going to pay it. And then what is going to happen is the results are going to be so skewed because they really don't expect a loss in this area. That is why they are charging so little premium, and the availability is—will be in question down the road.

So again, I go back to the safety issues. It is very critical that the safety issues are observed and critiqued and dealt with critically, because that, in itself, could blow the whole thing out of the water. And I am very cautious of the expense factor that these guys are up against. I mean, this is a tough road to hoe. They don't have any federal R&D money, and that is the killer. And you know, Mr. Kelly could tell you more companies than I could that have

failed already in the last four or five years because they didn't have the money. They were trying to do it themselves. It is so difficult, especially in this environment—economy, not environment. I am sorry. Economy.

Thank you.

Mr. WU. Dr. Hertzfeld.

Dr. HERTZFELD. I think we have to start with the premise that space is risky business. It is complicated. The failure rate of launch vehicles doesn't—is relatively high. It doesn't approach the safety record of commercial aviation. It doesn't even come close to it. And the barnstorming type of image is wonderful, and it is out there, and it does stimulate people, and it is certainly something good to have in our minds. Yet I agree with the balanced approach, because society itself in the United States is not in a barnstorming era. We are not in the 1910's or '20's or even '30's. We have developed a very sophisticated set of regulations to protect people, to protect life in all sorts of industries, not just space and aviation. So that—there is going to have to be a compromise met between people fully—people and companies just out there doing whatever they want to do and at the same time abiding by a lot of regulations, not just aviation and space ones. Environmental ones are big, for example, also.

One significant failure that costs human lives in human lives in commercial space flight could be catastrophic to the industry. And I think, as an example, when the Concord accident occurred a couple of years ago, they didn't fly the Concord for one full year. What company, particularly a small company, can survive without any revenues from their flight operations for a full year? And if we are talking small companies, in particular, in the sub-orbital human environment, it could very well be the end of them. After the Challenger incident, there were a number of small entrepreneurs involved in commercial experiments on the Shuttle. Many of them had to shut down because the Shuttle was not flying for a year or more.

So the risk is out there. They may be normal business risks, but space is riskier than other—many other endeavors, and we have to—we can't forget that. And the testing involved is expensive and costly. It is not launching—it is not taking off from an airport the way we can test a commercial aircraft. So that—as I said, I believe there is a balance that has to be met, but I don't think we can go back to an era of the 1920's at this point.

Thank you.

Mr. WU. I thank the Chairman for his indulgence, and I thank the panel for all of your thoughtful commentary. Thank you, Mr. Chairman.

Chairman ROHRABACHER. All right. And so just a couple of things. First of all, I would like to—one other anecdote. When I was a kid, I used to go out to the desert and rent motorcycles and I would ride all over. You know. It would be a great thing. It would be fun. You know. A group of friends of mine would be out there riding motorcycles. And you know, hey, it was dangerous, but we signed off. We were over 18, so we signed off and said, "If something happens to us, no problem. You rented to us. We can't sue you." So we had the opportunity to actually have a pretty good life.

I mean, it was really something I will never forget, and it was fun, and not to mention the drinking we did at night, but that is another whole other issue, which no one would sign off on, I guess. And by the way, when we were 18, we were permitted to drink in California in those days. So—well, we shouldn't get into that stuff.

But anyway, the point I want to make is when I go back now to the desert and the kids who are—you know, want to go out and experience what I did, they can't do it. They can't do it. So you have a generation now of young people who do not have the opportunity to rent a motorcycle and go out in the desert and do what I did. I think that is tragic. And the reason they can't is because they can no longer sign away this right to sue. You know. And I think, if anything, we have got—at least in this industry, at least when somebody is going up on top of a rocket and into space, they should be able to sign away their right to sue knowing that that is part of what you have to—in order to have the experience, that is what you have got to do. So I would hope that at least that is some kind of a consensus. Is that a consensus that people should have that right to sign away their right to sue? Does anyone disagree with that? If you are going to be a passenger, you should have that right. Okay.

Now something—and by the way, I would hope that whatever we do and whatever we come up with, whatever—and the bill has been—actually, we just put this bill through the process to get the discussion going. And obviously, this thing is going to be hotly debated and worked on by everybody in the Committee, and there will be lots of changes. And people are looking right now to try to make sure we do what is right. But I would hope that whatever comes out in this process, when you have got a fellow like Dick Rutan, who is an historic figure in the aviation business, he is out there, and he wants to put something into space not with any government subsidies, doing it with his own money, I would hope that there is something—that what we do in Washington, DC isn't something that prevents entrepreneurs like that and frontiersmen like that from doing it, from getting the job done. And if it is, if something we are doing here is going to keep his efforts grounded and prevent him from his accomplishments, there is something wrong.

Mr. WU. Mr. Chairman, may——

Chairman ROHRABACHER. Sure.

Mr. WU. Will the gentleman yield for a moment?

Chairman ROHRABACHER. Absolutely, Mr. Wu.

Mr. WU. I think the Chairman and I, at least for a period of time, grew up in roughly the same geographic area. And I remember those motorcycles in the desert, although I think I might have followed the Chairman by just enough time that the commercial operations were gone and—but private people were loaning motorcycles to each other going through the desert. But I want to bring that back home to something that the panelists said, which is I think back also to—I think they were called minibikes. Do you remember those?

Chairman ROHRABACHER. Right.

Mr. WU. They were kind of like a motorcycle—no, I am sorry, a lawnmower engine, a little tiny tire, and you get on those and they

would go, I don't know, 20, 25, 30 miles an hour. And there are these large housing tracks in southern California near where the Chairman currently lives. And we would zip through those neighborhoods at what, at my age, now seem like hair-raising speeds, but we never thought about some of the risks. And I don't recall ever putting on a helmet. And the point is, you know, my wife won't let the kids get on the bikes, on pedal bikes, without a helmet. And some things evolve over time, Mr. Chairman, and——

Chairman ROHRABACHER. Well, there is a——

Mr. WU [continuing]. We just need to find the right balance.

Chairman ROHRABACHER. But there is a halfway point between not being able to sign away your liability and requiring you to wear a helmet to make sure it is relatively safe. And I think that is what your whole presentation is about is where do you draw that line, which, of course, is what we are trying to do.

INDEMNIFICATION FOR VEHICLE OPERATORS

So now a couple final questions for the panel. First of all, should—let us just—with a show a hands, should the Government indemnify the vehicle operators for these new manned space private operations? Should the—there be a government indemnification for the people who are operating this vehicle? And if you could—so if we could just go down yes or no.

Mr. HUDSON. No.

Mr. KELLY. Yes.

Chairman ROHRABACHER. Mr. Kelly?

Mr. Duffy?

Mr. DUFFY. No.

Dr. HERTZFELD. No.

Chairman ROHRABACHER. No.

Ms. MEREDITH. Yes.

Chairman ROHRABACHER. Okay. How about should there be an indemnification of the passengers or a crewmember?

Mr. HUDSON. No.

Mr. KELLY. I would have to—I can't give a yes or no to that, because the panel is—the point that I haven't had time to assimilate, but——

Chairman ROHRABACHER. Okay. That is fair.

Mr. Duffy?

Mr. DUFFY. Private only, not government.

Chairman ROHRABACHER. Okay. So if Mr. Tito goes up, he is indemnified? Nobody can——

Mr. DUFFY. If he buys insurance.

Chairman ROHRABACHER. Nobody can—right. Nobody can sue Mr. Tito, but——

Mr. DUFFY. Any—you can sue anybody. It doesn't——

Chairman ROHRABACHER. Well, yeah. Okay.

Ms. MEREDITH. Yes, I think they should have indemnification. I don't see why they should be in any other different position than a satellite owner customer.

Chairman ROHRABACHER. Okay. That was a very important point in your testimony, as I have mentioned.

And finally, is indemnification necessary for a prosperous industry? Or will this industry thrive without indemnification?

Mr. HUDSON. Yes.

INDEMNIFICATION AND INDUSTRY SURVIVAL

Chairman ROHRABACHER. So you think it needs indemnification?

Mr. HUDSON. No, I would say I believe the industry will thrive without.

Chairman ROHRABACHER. It will thrive, because I was going to say, it sounded contradictory——

Mr. HUDSON. Right.

Chairman ROHRABACHER [continuing]. With what you said earlier.

Mr. Kelly.

Mr. KELLY. I think the industry can thrive without indemnification. I think it is a question of fairness to provide indemnification if you are going to give permission to fly.

Mr. DUFFY. I don't believe it is necessary.

Dr. HERTZFELD. The industry could survive.

Ms. MEREDITH. I think the industry is greatly helped by indemnification, because all of the foreign competitors have it.

Chairman ROHRABACHER. Okay.

Mr. DUFFY. There aren't any foreign competitors who are launching people in space, though. That is——

MANNED VS. UNMANNED REGULATION

Chairman ROHRABACHER. Okay. Well, this is—and now I do have one other thing here. Now in terms of the FAA and it seems to me—do we need more than a—okay, the point that you made, should we have—should there be more regulation required of a manned space flight than of a space flight that is not manned? In other words, could—should we require two approvals be necessary to launch a vehicle with manned space flight perhaps, a two-tiered approach, or can—should we just require the same type of safety that we require from someone launching an unmanned vehicle?

Mr. HUDSON. I certainly don't believe there should be two tiers of regulation. I think——

Chairman ROHRABACHER. The same? It should be about the same?

Mr. HUDSON. Whatever we adopt ultimately should apply to both piloted and—or human space flight and non-human space flight.

Chairman ROHRABACHER. Okay.

Mr. Kelly?

Mr. KELLY. I don't believe that we should adopt anything more than is required for normal RLV licensing, which already covers eventualities, such as passengers somehow being in a safety-critical position that would affect the flight and cause third-party damage. There isn't anything more that is needed.

Chairman ROHRABACHER. Okay.

Mr. Duffy?

Mr. DUFFY. Well, I believe that the—that regulations would be needed in order to make it the equivalent of the aviation industry and generally the airline industry, perhaps not to that degree, but certainly to make it safe. It is paramount——

Chairman ROHRABACHER. Yes. Are airplanes—the question is do—when you have a cargo airplane, if you have just a line that carries only cargo, do they have to have the same regulations as those carrying passengers or is it further—is it more restrictive of airplanes—are the regulations more restrictive of airplanes that carry passengers as compared to cargo?

Mr. HUDSON. They are essentially comparable, but there is—there are slight differences. There can be slight differences.

Chairman ROHRABACHER. Slight differences. Okay.

Mr. Hertzfeld?

Dr. HERTZFELD. I don't think a two-tiered system is good, but there may be some modifications to accommodate humans on what exists now, if you need it.

Ms. MEREDITH. I think some minimum regulation of the safety of the passenger is in order.

Chairman ROHRABACHER. Okay. Well, I want to thank all of you for helping us today. And you have certainly stimulated a lot of thought, and we are taking this very seriously, because we don't want to see Dick Rutan or any of these other entrepreneurs or wildcat-ers or barnstormers, whatever you want to call them, grounded because of something we are doing or not doing here in Washington. We want to make sure we are doing the right thing, and if there is an impediment, it is because it is the right thing to do and not because we have just been frivolous with our regulations. So we are taking this issue very seriously, and you have helped us today immensely.

So please be advised that the Subcommittee Members may request additional information for the record, and I would ask other Members who are going to submit written questions do so within one week of this hearing.

And now is there something else I need to say officially to end the hearing? Okay. So again, thank you very much, and this concludes the hearing. And we are now adjourned.

[Whereupon, at 12:21 p.m., the Subcommittee was adjourned.]

Appendix 1:

Answers to Post-Hearing Questions

ANSWERS TO POST-HEARING QUESTIONS

Responses by Gary C. Hudson, Chief Executive Officer, HMX, Inc.

Questions submitted by Chairman Dana Rohrabacher

Q1. H.R. 3245 directs the Secretary of Transportation to arrange for the National Academy of Public Administration (NAPA) to conduct a study on the existing liability-risk sharing regime for commercial space transportation.

Q1a. Given that the Federal Aviation Administration issued a study regarding the liability risk-sharing regime for U.S. commercial space transportation in April 2002, is another study necessary? If so, what new or additional information is needed?

A1a. I believe that a new study of the liability risk-sharing regime for U.S. commercial space transportation is unnecessary.

Q1b. Should any new study be limited to the liability-risk sharing regime for commercial human space transportation (as opposed to the entire commercial space transportation industry)?

A1b. Not applicable in view of (1a) response above.

Q2. Since its enactment, the commercial space launch indemnification regime has been subject to an expiration date. H.R. 3245 extends indemnification by three years through December 31, 2007. What effect(s) would a phase-out or elimination of the indemnification regime have on the U.S. commercial space transportation industry generally and the emerging commercial human space flight industry in specific?

A2. The history of third party liability claims related to U.S. commercial space launch accidents is almost non-existent. Given this, I do not believe that elimination of the indemnification regime would in fact cause any significant harm to the existing space launch industry. From a practical point of view, I also do not believe that there would be significant harm to the emerging industry, but it is always possible that there might be limited perceptual harm. (By this I mean some investors or customers might fear that they would be impleaded in any suit that alleges damage from launch or re-entry accidents, and this might cause them to withdraw support or business form a smaller launch provider who would not otherwise have the resources to prevail in a major legal action. This concern would be frankly overblown, but nonetheless might exist for unsophisticated backers and customers.)

Q3. Your testimony argues that the aviation experimental certification model should be used to regulate commercial human space flight. Presumably, however, the vehicles used for commercial human space flight will differ considerably from experimental aircraft in terms of design and purpose. Given this assumption, how might the experimental aircraft regulatory model be adapted for commercial human space flight?

A3. The differences between "conventional" experimental aircraft and commercial human space flight vehicles are ones of perception rather than actual third party risk. First, there is really no such thing as a conventional experimental aircraft. Such machines range the gamut from lightweight amateur home-built aircraft to rocket powered vehicles (EZ-rocket) and supersonic aircraft (including SpaceshipOne's recent flight under experimental rules). They also include 777 class aircraft prior to FAA issuance of standard type certification permitting revenue service and converted and modified military jets. Second, the real question is how much damage to third parties can such vehicles produce? I have heard no evidence from FAA/AST or any other presumed knowledgeable party that suggests that a vehicle of the class of SpaceShipOne (to offer a specific example) can in fact produce any more damage than a light business jet or a heavy turbine aircraft, both of which may be flown in the experimental category. In fact, the worst-case accident that could be cased by SpaceShipOne would be a nose over flight into the ground under rocket thrust immediately after release from its carrier aircraft. Ironically, this accident could occur right now, as SpaceShipOne flies under an experimental certificate. In fact, as it flies higher and faster, it offers less risk to third parties since the aircraft is more likely to break up in the air from aerodynamic loads, producing a larger debris field but smaller mass of individual debris elements each with a reduced potential for harm. Therefore to answer the question, I believe that there are no human space flight vehicles being considered for which the risk is greater to third

parties than for aircraft which currently operate under AVR experimental type certificates, nor are there likely to be any built in the foreseeable future.

Q4. Your testimony advocates the elimination of "launch licenses" in favor of reapplication of FAR 101 to conduct unmanned rocket launches. Please describe how this approach would work in practice. What are the benefits of this approach?

A4. It is important to distinguish between unmanned rockets (sub-orbital or orbital) and piloted human space flight vehicles. I propose extension of experimental certificates to the latter class of vehicles. I also proposed in my testimony to dis-establish the FAA/AST office. If this were done, some mechanism must be in place to allow a minimalist regulatory regime that permits launch of unmanned rockets. I proposed that the old FAR 101 be once again employed. The first large launch vehicle built in this country was approved for flight (not licensed) under FAR 101. The procedure at that time (1981) was to file a request for flight approval with a regional FAA office following the procedures outlined in the FAR. Once done, approval was almost always granted on a time scale measured in a few days. My total cost for the application was $2,000, all for legal fees. We chose to use an attorney for our first application in order to be assured of meeting all the requirements, but subsequent applications could have been done administratively, and would have cost virtually nothing. One can compare this form of approval with current launch licensing which can cost a million dollars per flight in time and effort, including five hundred or (more likely) thousands of hours of applicant's time just to prepare the application, plus taking two or more years to issue, according to AST's own briefings. If there was evidence that AST's procedures had enhanced the public safety, an argument might be made for their continued existence, but there is *no evidence* of any public safety benefit. There is only the cost to taxpayers measured at $100 million over the past twenty years and that much again for the next decade, plus the inhibitory effect of their policies as are now being seen on the only flying human space flight vehicle project in this country.

Questions submitted by Representative Bart Gordon

Q1. Section 4 of H.R. 3245 includes a provision that says:

> *"The Secretary of Transportation shall. . .focus the Department's regulation of commercial human space flight activities on protecting the safety of the general public, while allowing space flight participants who have been trained and meet license-specific standards to assume an informed level of risk."*

Q1a. That language would appear to preclude DOT from regulating passenger safety on commercial passenger-carrying spacecraft. Do you consider that to be an appropriate public policy? Why or why not?

A1a. In the near-term, commercial human space flight vehicles will carry only space flight participants who have decided to travel in such vehicle for sport or entertainment purposes. The vehicles will not be used for the common carrier purpose of point-to-point transportation of people or cargo. In light of this fact, I believe that it is appropriate public policy to regulate such vehicles only for the purpose of protecting the interest of third parties, and not the space flight participants. For example, we do not regulate the sport of mountain climbing, because all the participants take part of their own free will. Likewise, we do not regulate auto racing, even though we do regulate travel by automobile.

Q1b. If you think that DOT should not regulate passenger safety at the present time, is there any point in the future when the government should become involved in such regulation?

A1b. DOT should regulate commercial passengers on space flight vehicles when the vehicles are used for point-to-point flight for the purpose of transportation and not sport. That time lies fairly far into the future at the current pace of progress.

Q2. What information do you believe a commercial human space flight company would have to provide to allow a potential passenger to give his or her "informed consent"? For example, what constitutes sufficient information on a vehicle's safety record, if the vehicle has only flown a statistically insignificant number of times?

A2. I believe that a commercial space flight company offering sport rides to a paying or nonpaying customer should be obliged to inform the participant of the experimental nature of the vehicle, and to state clearly that it has not be subjected to FAA

or government certification. (This is done for experimental aircraft today.) I also believe that the records and flight history of the particular vehicle type and tail number should be available for inspection by the participant or their agent.

Q3. H.R. 3245 says that a license holder may launch a paying passenger into space only if "the space flight participant has received training and met medical or other standards specified in the license."

Q3a. Do you agree with the provision?

A3a. I strongly believe that government has no public policy interest in requiring any space flight participant to have met any medical standards. We do not require such training or medical certification for other extreme sports.

Q3b. Who should set the standards and determine the appropriate level of training?

Q3c. Who would certify that the training had been done?

Q3d. Should the specified standards be uniform across the industry? If not, how would you make it work in practice?

A3b,c,d. In view of this response, questions (b) through (d) are not applicable. I would like to also point out that medical standards and training requirements may well be imposed upon potential space flight participants by the operators of some human space flight vehicles, but they will be doing so for insurance purposes.

ANSWERS TO POST-HEARING QUESTIONS

Responses by Michael S. Kelly, Technical Manager, Northrop-Grumman/Xon Tech

Questions submitted by Chairman Dana Rohrabacher

Q1. H.R. 3245 directs the Secretary of Transportation to arrange for the National Academy of Public Administration (NAPA) to conduct a study on the existing liability-risk sharing regime for commercial space transportation.

Q1a. Given that the Federal Aviation Administration issued a study regarding the liability risk-sharing regime for U.S. commercial space transportation in April 2002, is another study necessary? If so, what new or additional information is needed?

A1a. The study performed by the Federal Aviation Administration regarding liability risk-sharing for U.S. commercial space transportation in April 2002 is a thorough, extremely competent work. There is more basic information and detailed, thoughtful analysis in the 289 pages of the published report than anyone, me included, has had time to fully absorb and process. I do not believe that it is in the taxpayers' interest to endlessly repeat work already done, particularly in a case, such as this, when the original work was done so well.

There are certainly new questions regarding human space transportation that have arisen since the FAA study was published. Ms. Meredith's point regarding third party suits against wealthy *passengers,* raised in the 5 November 2003 hearing, is a case in point. I do not believe, however, that such questions yet merit a formal government study. They are things best debated, for the time being, within the industry itself.

Q1b. Should any new study be limited to the liability-risk sharing regime for commercial human space transportation (as opposed to the entire commercial space transportation industry)?

A1b. The question correctly notes that the scope of the FAA study was very broad, and suggests that a more sharply focused study pertaining to human space flight may be needed. Once again, I do not believe that there are questions pertaining to human space flight that have as yet achieved either the level of definition or the urgency to merit a federal study.

Questions submitted by Representative Bart Gordon

Q1. Section 4 of H.R. 3245 includes a provision that says:

> *"The Secretary of Transportation shall. . .focus the Department's regulation of commercial human space flight activities on protecting the safety of the general public, while allowing space flight participants who have been trained and meet license-specific standards to assume an informed level of risk."*

Q1a. That language would appear to preclude DOT from regulating passenger safety on commercial passenger-carrying spacecraft. Do you consider that to be an appropriate public policy? Why or why not?

A1a. I disagree to some extent that DOT is precluded from regulating passenger safety on commercial passenger-carrying spacecraft. The language "allows" people who have been trained "and meet *license-specific standards* [emphasis added]" to assume an informed level of risk. This inherently builds the potential for a regulatory mechanism into passenger safety on commercial passenger-carrying spacecraft, in that it allows the possibility of a license not to the liking of FAA to be denied.

The current licensing rule, as well as the *Commercial Space Act of 2003,* do no give FAA the authority to deny licenses on the grounds of passenger safety, but the *potential* is there should future legislation and subsequent rule-making put it in place.

However, the basic assumption of the question, that DOT is precluded by H.R. 3245 from regulating passenger safety, is correct. I do consider that appropriate public policy. Nowhere in the Constitution is the United States government given the authority or power to protect people from the consequences of their own choices and actions. That Congress occasionally does pass legislation attempting enforce

such "protection" is not proof that such legislation is legitimate. All it means is that Congress has acted outside of its authority.[1]

It is not the business of the government to "allow" people to do things they want to do. On the contrary, it is the people who allow the government to do what it does (through the Constitution and its processes), and to stop it when it exceeds its authority. Any regulation of voluntary activity for the purpose of protecting people from the consequences of their own actions exceeds the authority of the government, and is a threat to basic human freedom.

Q1b. If you think that DOT should not regulate passenger safety at the present time, is there any point in the future when the government should become involved in such regulation?

A1b. I do not believe there is ever a need for such regulation.

Q2. What information do you believe a commercial human space flight company would have to provide to allow a potential passenger to give his or her "informed consent"? For example, what constitutes sufficient information on a vehicle's safety record, if the vehicle has only flown a statistically insignificant number of times?

A2. This is good question, because the answer provides the foundation for the responses to questions 1a and 1b.

In any sales/purchase transaction between two private parties, it is the moral obligation of the seller to disclose pertinent information and of the buyer to ask enough questions to make an informed purchase agreement. When it comes a transaction involving significant risk to life and limb, such as purchase of a ride in a space plane, the moral obligations on the parts of each party are elevated significantly. A seller who hides a poor safety record, or portrays the level of risk as anything other than what it is, is a villain. A buyer who doesn't ask if what he is doing is risky is a fool.

A seller of rides in space, mountain-climbing expeditions, scuba-diving trips, etc., who fails to disclose known risks or, worse, known *problems,* is open to legal action should an accident ever occur. Such a person is a fraud, who can and should be taken to task.

Anyone who buys such an experience without asking what the risks are is either foolish, or considers the burden of thinking about asking questions to be greater than suffering the loss of his or her own life. There is no way to protect such people, other than to deprive the rest of the population of its basic human right to travel in space by forbidding it.

Aside from the inevitable lawsuits that will result when people start flying as passengers in space (and they are inevitable), the best protection for both seller and buyer is full disclosure. The question of what constitutes sufficient information if the vehicle has flown a statistically insignificant number of times is an excellent one. It reflects the fact that "full disclosure" is not a static term, since the information possessed even by the seller is limited by his or her flight experience.

This is important to note, because it is a *fact.* In other words, as much as we may wish it were otherwise, as much as we may desire to provide all the answers, it is a fact of reality (and therefore unchangeable by legislation) that we will not have all of the answers in the beginning. More and more flight experience will provide the sellers with the experience they need to run a safe operation, the prerequisite to a profitable business.

There is no need for a regulatory requirement on the level of disclosure, since the market will ultimately control it. Furthermore, any attempt to impose such a requirement will guarantee one thing: there will never be a case of passenger injury in space flight, because there will never be any passenger space flight.

The burden on RLV developers imposed by the relatively simple launch licensing rule now in effect is almost insurmountable, and threatens the future of the industry. That is in part due to the fact that, when we crafted the rule, we did not know how to ask all the right questions. Mind you, I supported the rule-making process, and thought—in fact, still think—that we did a very good job. Now that we have more information, we find that the rule is too vague in some areas, and too specific in areas where no specificity is physically possible. All parties are doing what they can to deal with these problems.

Setting any regulatory requirement on level of disclosure will beg *unanswerable* questions. An unanswerable question will, of course, never be answered, and if passenger space travel must await answers that never come, it will never happen.

---

[1] The government does *not,* for example, regulate hang-gliding, mountain-climbing, roller-coasters and other thrill rides, etc. Nor should it.

All human activity involves risk. The degree of risk, and how it is perceived, both change with experience. When people approach anything they do not understand, they assign it an arbitrarily high, unquantified level of risk. This is a survival trait of the species (not unique to ours, I might add). As we gain knowledge of things, we tend to place their levels of risk in a more realistic hierarchy, and even quantify those risks where possible. *What* we consider a risk may turn out not to be so, while risks we hadn't considered will always manifest. Furthermore, as we gain experience doing anything, the degree of risk itself changes. It tends to decline with practice. Technology improvements, historically, drive risk down. But this entire dance of activity and risk has one absolute prerequisite: we have to engage in the activity.

There is no shortcut to this process. We cannot sit around and think about things forever and expect risk to go down. There is no substitute, in reality, for the activity itself. There is no regulatory magic wand that will prevent accidents from happening, apart from stifling all human activity to the extent that no one ever takes a risk. That is contrary to human nature, and to American nature in particular.

In my own dealings with people, I always believe in giving them any information they want to make a good decision. I don't understand how anyone can operate on any different set of rules. If I were offering passenger space flight, I would give passengers as much information as they could absorb, and, in fact, more that they would probably want or need. I would do so even if it cost a sale—in fact, I *have* done so, even when it cost a sale. It is not in anyone's interest to do otherwise. But it is even less in peoples' interests to attempt to regulate such disclosure.

Q3. H.R. 3245 says that a license holder may launch a paying passenger into space only if "the space flight participant has received training and met medical or other standards specified in the license."

Q3a. Do you agree with the provision?

A3a. From the standpoint of good practice, I don't see how anyone could disagree with providing training to or requiring necessary medical standards of a passenger on a commercial space flight. I am uneasy about placing it into law, simply because it opens a door to the government taking future regulatory action that it has no Constitutional authority or moral right to take.

Q3b. Who should set the standards and determine the appropriate level of training?

A3b. Standards for training in other hazardous activities, such as scuba diving, parachuting, hang-gliding, etc., are often set by industry associations. Initially, each flight provider will set his or her own standards.

In fact, it is part of the natural evolution of business that individual companies set the standards initially, and the ones who do the best job of it have their standards adopted by the rest of the industry.

Q3c. Who would certify that the training had been done?

A3c. Initially, the company itself will certify that the individual is fully trained. Do not equate this with "rubber stamping." Any certification that is genuinely required (and no one, at this time, knows what is, or even *if* any is) will emerge as the industry evolves, and those companies that provide it will survive while those that do not will not.

In all likelihood, one or more industry associations will ultimately emerge that will set standards for both training and certification of training, if indeed it is necessary. I must stress, however, that *no one* knows or could know at this time *if* any training is required, let alone what it would be.

Q3d. Should the specified standards be uniform across the industry? If not, how would you make it work in practice?

A3d. Once again, it is not a given that any training is required, nor is it a given that passengers need to meet any medical requirements.[2] One of the reasons why it is not a given is that there is no single design solution for a passenger spacecraft.

It is impossible to predict what technologies will win in the marketplace. Assuming, however, that at some point a spacecraft design solution emerges that becomes widely adopted, and requires training of passengers, there will unquestionably emerge an industry association that will provide standards.

This is happening with Reusable Launch Vehicles as I write. The American Institute of Aeronautics and Astronautics has a working group that is now working to set various standards for RLVs. Though a bit premature (given that there is nothing

[2] In fact, I would turn that question around and ask how such requirements could be imposed in the face of the Americans With Disabilities Act.

to standardize), this sort of practice is the standard for standards in all industries. I would expect nothing different in the passenger space flight industry.

ANSWERS TO POST-HEARING QUESTIONS

Submitted to Raymond F. Duffy, Jr., Senior Vice President, Willis InSpace Insurance Underwriters

These questions were submitted to the witness, but were not responded to by the time of publication.

Questions submitted by Chairman Dana Rohrabacher

Q1. H.R. 3245 directs the Secretary of Transportation to arrange for the National Academy of Public Administration (NAPA) to conduct a study on the existing liability-risk sharing regime for commercial space transportation.

Q1a. Given that the Federal Aviation Administration issued a study regarding the liability risk-sharing regime for U.S. commercial space transportation in April 2002, is another study necessary? If so, what new or additional information is needed?

Q1b. Should any new study be limited to the liability-risk sharing regime for commercial human space transportation (as opposed to the entire commercial space transportation industry)?

Q2. Since its enactment, the commercial space launch indemnification regime has been subject to an expiration date. H.R. 3245 extends indemnification by three years through December 31, 2007. What effect(s) would a phase-out or elimination of the indemnification regime have on the U.S. commercial space transportation industry generally and the emerging commercial human space flight industry in specific?

Q3. Presumably, the vehicles used for commercial human space flight will differ considerably from experimental aircraft in terms of design and purpose. Given this assumption, how might the experimental aircraft regulatory model be adapted for commercial human space flight?

Q4. H.R. 3245 includes pre-qualification criteria for space flight participants, but none for crew members.

Q4a. Are the pre-qualification criteria listed for passengers in H.R. 3245 sufficient? Should criteria be added or deleted?

Q4b. Should the bill include pre-qualification criteria for crew members?

Questions submitted by Representative Bart Gordon

Q1. Section 4 of H.R. 3245 includes a provision that says:

> *"The Secretary of Transportation shall. . .focus the Department's regulation of commercial human space flight activities on protecting the safety of the general public, while allowing space flight participants who have been trained and meet license-specific standards to assume an informed level of risk."*

Q1a. That language would appear to preclude DOT from regulating passenger safety on commercial passenger-carrying spacecraft. Do you consider that to be an appropriate public policy? Why or why not?

Q1b. If you think that DOT should not regulate passenger safety at the present time, is there any point in the future when the government should become involved in such regulation?

Q2. What information do you believe a commercial human space flight company would have to provide to allow a potential passenger to give his or her "informed consent"? For example, what constitutes sufficient information on a vehicle's safety record, if the vehicle has only flown a statistically insignificant number of times?

Q3. H.R. 3245 says that a license holder may launch a paying passenger into space only if "the space flight participant has received training and met medical or other standards specified in the license."

Q3a. Do you agree with the provision?

Q3b. Who should set the standards and determine the appropriate level of training?

Q3c. Who would certify that the training had been done?

Q3d. Should the specified standards be uniform across the industry? If not, how would you make it work in practice?

Q4. Your testimony focuses on a number of insurance issues.

Q4a. What is the current state of the insurance industry that writes insurance for aviation and space activities?

Q4b. Do you see the outlook for that insurance industry changing—either for better or for worse—over the next few years? Why?

Q4c. Is insurance for space activities getting more expensive or less expensive?

Q4d. What do you think the impact of new commercial human space flight companies seeking insurance will be on the overall situation in the insurance industry?

ANSWERS TO POST-HEARING QUESTIONS

Responses by Henry R. Hertzfeld, Senior Research Scientist, Elliot School of International Affairs, George Washington University

Questions submitted by Chairman Dana Rohrabacher

Q1. H.R. 3245 directs the Secretary of Transportation to arrange for the National Academy of Public Administration (NAPA) to conduct a study on the existing liability-risk sharing regime for commercial space transportation.

Q1a. Given that the Federal Aviation Administration issued a study regarding the liability risk-sharing regime for U.S. commercial space transportation in April 2002, is another study necessary? If so, what new or additional information is needed?

A1a. The FAA study on liability and risk-sharing was well-done and thoroughly covered the history, legislation, regulations, and issues. There should be no need for another large comprehensive study of this topic so soon after that study. However, the FAA is responsible for promoting the launch vehicle industry and therefore the recommendations reached in that study regarding the necessity of retaining and extending the current indemnification scheme were, perhaps, a foregone conclusion since the launch vehicle industry considers this indemnification extremely important.

It might be beneficial to commission a study by an objective, disinterested party on the relative merits of either continuing, modifying, or eliminating the government indemnification. NAPA might not be the most objective organization in this regard since it has a long history of studies of space for NASA and other space-related agencies. I would suggest an organization within the insurance industry (possibly one involved in insuring nuclear facilities since there are direct parallels between the evolution of the PriceAnderson Act and government space indemnification) or a major university business school with a strong insurance department.

Q1b. Should any new study be limited to the liability-risk sharing regime for commercial human space transportation (as opposed to the entire commercial space transportation industry)?

A1b. The study should approach commercial human space flight as a sub-issue under the general framework of space indemnification. The package of regulations on insurance for space activities should be integrated into a logical unit rather than a series of *ad hoc* rules.

Q2. Since its enactment, the commercial space launch indemnification regime has been subject to an expiration date. H.R. 3245 extends indemnification by three years through December 31, 2007. What effect(s) would a phase-out or elimination of the indemnification regime have on the U.S. commercial space transportation industry generally and the emerging commercial human space flight industry in specific?

A2. It is hard to determine what the effect would be. Since many foreign nations which compete with U.S. launch vehicles do indemnify their launches for third-party liability risks, it is clear that eliminating that subsidy would make U.S. launches less competitive, at least in the near-term. However, there are many other factors behind risk-taking and indemnification in the space industry that may provide arguments minimizing this anti-competitive effect.

First, third-party liability insurance is not that expensive for large companies and for proven launch vehicles. Payouts for third-party damage worldwide have been extremely small over the entire history of space launches and the probability of significant damage is low.

Second, since the U.S. is the preeminent space faring nation, most other nations have followed the U.S. example in many areas of space licensing and regulations. There are, of course, major differences among nations, but it is quite possible that, over time, if the U.S. eliminated the indemnification provisions others would follow. However, all nations, including the U.S., would still be ultimately liable for this type of damage from a vehicle launched from their nation (or for which their citizens were significantly involved). That would put the burden of the regulatory agency within each nation to require financial responsibility for each launch sufficiently high that the governments would not have to provide additional funds in the event of a lawsuit. Governments, however, would still be the insurer of last resort.

Third, currently most U.S. launch vehicles are covered by P.L. 85–804 (government indemnification for ultra hazardous activities connected with national secu-

rity). The details of this are complex, but without this indemnification it is likely that the EELV and other new launch vehicles would not have been built. The question is one of dual-use: if the vehicles covered by this law are used for purely civilian activities, can P.L. 85–804 be used? It may be possible for vehicles necessary for defense purposes, but new sub-orbital human-rated vehicles without military uses would clearly not be covered by P.L. 85–804. This area needs to be further studied.

Q3. H.R. 3245 includes pre-qualification criteria for space flight participants, but none for crew members.

Q3a. Are the pre-qualification criteria listed for passengers in H.R. 3245 sufficient? Should criteria be added or deleted?

A3a. I am not an expert in this area.

Q3b. Should the bill include pre-qualification criteria for crew members?

A3b. It is logical that criteria for crew members should be established for reasons of the safety of passengers and other crew members. The question of what criteria are most appropriate might more properly be addressed by a regulatory body after considerable study and industry inputs.

Questions submitted by Representative Bart Gordon

Q1. Section 4 of H.R. 3245 includes a provision that says:

"The Secretary of Transportation shall. . .focus the Department's regulation of commercial human space flight activities on protecting the safety of the general public, while allowing space flight participants who have been trained and meet license-specific standards to assume an informed level of risk."

Q1a. That language would appear to preclude DOT from regulating passenger safety on commercial passenger-carrying spacecraft. Do you consider that to be an appropriate public policy? Why or why not?

A1a. As I read the language, it may not preclude the regulation of passengers and passenger safety. It depends on the interpretation of "space flight participants" coupled with an interpretation of what type and extent of "risk" is to be considered sufficient to meet a criteria of "informed." If the definitions are set low (i.e., all conceivable types of risk are included in the requirement of being informed; all possible people are included as space flight participants, etc.), then the license procedure of the DOT may be comprehensive and include regulations concerning passengers. In effect, protecting the general public from harm can be viewed from the perspective that any passenger who many be marginal in any sense (physical, mental, security, financial, etc.) can be seen as a potential danger to the safety of the flight and therefore to the general public.

Given that possibility, given the sensitivity of the U.S. Government to security issues, and given that any rocket launch can be seen as a possible national security threat (just as any commercial airplane flight is now viewed after 9/11), the wording of the language in the bill should be more precise and should include at least a narrow opening for the DOT to regulate some aspects of passenger safety on spacecraft.

I think the intent of the bill is to allow incentives for risk-takers and entrepreneurs to fly in spacecraft. That could be accomplished by establishing regulations that only affect the safety of others, defined as both other passengers, employees of the company providing the launch and their contractors, and the general public. If drafted carefully, this could open up risk-taking in several important areas: financial, and personal. There should (other than requiring either the person and/or the launch company to have a necessary amount of third-party liability insurance) be enough flexibility to allow a person to risk his or her life and money on the flight but not endanger others.

The use of the term, space flight participant, is interesting and a good choice of words. In the U.N. Treaty on the Rescue of Astronauts, there is no definition of an astronaut. However, the language of the title of the treaty is different from the body of the treaty where the term "personnel of a spacecraft" is used. That enables the Treaty to cover Astronauts, Cosmonauts, Pilots, Passengers, Mission Specialists, etc. and makes no distinction between nations, languages, civilians, government employees, etc. By using the term "participant" in H.R. 3245, a similar comprehensive coverage to anyone onboard (and possibly those on the ground supporting the flight) is included.

In today's environment, it is good public policy to protect safety while permitting economic and financial risk-taking. By trying to deregulate (or not regulate) this activity using a model loosely built on the aviation era of the 1920s—very laissez-faire

in all aspects—the Congress would be out of sync with the basic regulatory and legal foundation of industry and activity today. Space flight today is not the same as aviation was in its early days and the free-wheeling model is not appropriate. Congress should attempt to provide as much entrepreneurial freedom as possible for space, but not try to recreate something that can't be recreated.

Q1b. If you think that DOT should not regulate passenger safety at the present time, is there any point in the future when the government should become involved in such regulation?

A1b. I have suggested above limited regulation. That could be expanded later if conditions warranted.

Q2. What information do you believe a commercial human space flight company would have to provide to allow a potential passenger to give his or her "informed consent"? For example, what constitutes sufficient information on a vehicle's safety record, if the vehicle has only flown a statistically insignificant number of times?

A2. I have no strong opinion on this. Regulations on what information should be provided will depend on many factors and this would probably best be determined through a fact-finding study and a mutually agreed upon set of standards between the DOT and industry. Clearly, over time, these factors would change and therefore the law should allow for an administrative process to determine the standards. For example, a vehicle's safety record (number of successful launches) is only part of the picture. What about cabin conditions (air quality, for example), exposure to radiation (can depend on flight path, latitude, season of the year, and activity of the sun), financial responsibility of the company and its subcontractors, etc.?

Q3. H.R. 3245 says that a license holder may launch a paying passenger into space only if "the space flight participant has received training and met medical or other standards specified in the license."

Q3a. Do you agree with the provision?

A3a. Yes. As in my answer to Question 1, the safety of others may be involved. A good quick example is the well-known risk factors associated with radiation. A woman who is pregnant is at much higher risk and even today would be excluded from flying on the Shuttle or other space vehicles.

Q3b. Who should set the standards and determine the appropriate level of training?

A3b. This would have to be the regulating agency such as the DOT. If standards are set, there can always be put in place a system for a waiver of the rule in the case where an individual is both willing to take a risk and that risk would pose no danger to others. (For example, if a person with a disability that ordinarily would preclude him or her from the flight could prove on a case-by-case basis that their disability would not cause harm to others.)

Q3c. Who would certify that the training had been done?

A3c. The regulatory agency could establish a mechanism for doing this—either through their own procedures or by accepting the certificate of a qualified private sector person or firm.

Q3d. Should the specified standards be uniform across the industry? If not, how would you make it work in practice?

A3d. General standards should be established. The system should be flexible enough to accommodate different types of flights and different specifics for vehicles and situations.

Q4. In your testimony you state that the cost of insurance "is only a small fraction of the total cost of a launch and would be included in the price of a launch. Those incurring the risk should be willing to pay for the risk, particularly where there is no direct Government benefit from the activity."

Q4a. What do you estimate that fraction would be?

A4a. I was referring to the cost of third party liability insurance as currently provided for commercial communications satellite launches. (This is the only large commercial activity in space right now and therefore is the best example for comparison, even if there are significant differences between this and human flight). When the cost of the satellite itself, the launch, and insurance are added together, they are small in comparison to the total revenues generated over the long (5- to 15-year) lifetime of the satellite. This is why communications companies consider space a

profitable investment and make money on the investment even with the very high current launch costs.

Liability insurance is also much less of a problem for large companies than for smaller ones and for new start-ups. There is no current market for insurance for human space flight of the type that would be covered by H.R. 3245. It is highly probable that insurance costs would be high in the initial years (until a track-record of success would be developed). And, since revenues from human space flight are flight-specific, insurance and launch costs in general cannot be amortized over many years as with communications satellites. Furthermore, insurance costs fluctuate with the availability of insurance generally (i.e., the pool of available insurance funds varies depending on the payouts for other events such as major hurricanes or other disasters) and predicting the possibility availability and cost of insurance for human space flight in advance is difficult.

Q4b. Would that fraction be significantly smaller if the indemnification regime in existing law were extended to commercial human space flight activities, or would there be no appreciable impact?

A4b. See above. The cost would be greater for human space flight, at the very least as a percentage of revenues.

Q4c. Would the absence of government indemnification have any impact on the ability of a commercial human space flight company to get insurance?

A4c. Possibly. The real question is whether the government should subsidize commercial human space flight where there is no apparent direct connection between a government purpose and the flight. Up to now virtually all spacecraft in orbit have some government interest. Even the purely commercial communications satellites provide necessary back-up capabilities for the military and security interests of the U.S. Government. Human space flight is aimed at recreation and at entertainment. It should be left up to Congress to determine whether that economic activity has a sufficient public purpose to warrant indemnification.

I think that making the public purpose argument for commercial human space flight would be difficult. There is no reason why the full cost of liability insurance should not be born by the company. By requiring through regulation that a company purchase "enough insurance to cover all potential third party losses," the government would set a precedent for commercial operations that helps to develop a full-cost profit basis for the future. And, even though other nations might subsidize this type of insurance, it is quite possible that if the U.S. as the leader in space sets this commercial precedent, others will follow.

Clearly, if a third party is damaged in another country by a U.S. space flight, the U.S. Government could still be liable under U.N. Outer Space Treaties. The likelihood of an incident and payout by the government is low, but not zero, even if the government removes the indemnification from commercial human space flight. That possibility alone will require some regulation on determining how much insurance is "enough" for each flight or category of flight by a regulatory agency. The current DOT/FAA assessment of requiring "maximum probable loss" would probably not provide a high enough insurance threshold and an assessment approaching a limit of "maximum possible loss" might have to be substituted. How much of a financial difference this would make in the cost of insurance is indeterminate since insurance would be purchased on a specific vehicle and/or series of flights. It would, nevertheless, be more expensive.

ANSWERS TO POST-HEARING QUESTIONS

Responses by Pamela L. Meredith, Counsel, Zuckert, Scoutt & Rasenberger, LLP

This response addresses some but not all of the questions, or aspects of the questions, of Representatives Dana Rohrabacher and Bart Gordon. Clearly, the answers to each of the questions could easily be the subject of a lengthy dissertation, which is not the purpose of this brief response. The response is based on the text of H.R. 3245 provided for the November 5, 2003 hearing.

Questions submitted by Chairman Dana Rohrabacher

Q1. If an accident were to occur due a commercial human space flight launch by a U.S. citizen or company resulting in harm to the space flight participants (passengers) and crew, as well as harm to foreign or domestic "third parties," in what jurisdictions might claimants bring suit and against whom? What domestic laws, international laws, treaties, or agreements might be implicated?

A1. Without Commercial Space Launch Act ("CSLA")[1] waivers of liability, the passenger could be sued by, and could itself sue, the launch company and its contractors and subcontractors involved in launch services, as well as fellow passengers. H.R. 3245[2] does not impose a waiver requirement with respect to passengers.[3] The passenger could also be sued by "third parties" (innocent bystanders) who are injured or whose property is damaged. The passenger would not have the benefit of third party liability insurance protection or United States Government Indemnification ("USG Indemnification") as H.R. 3245 is currently drafted. The passenger could be held liable to these parties for negligence, gross negligence, reckless conduct, or willful misconduct under applicable U.S. state tort laws for any injury or damage he or she caused.

Passengers With CSLA Waivers

The CSLA mandates waivers among the launch company, the satellite customer, and their respective contractors or subcontractors.[4] Section 3(d)(2) of H.R. 3245 does not make clear that the CSLA waiver applies to passengers; although, it appears from the preamble of H.R. 3245 that the intention is to extend the waiver to passengers.[5]

If passengers are required to sign reciprocal waivers of the kind currently mandated by the CSLA, then the launch company, fellow passengers, and the launch company's contractors and subcontractors involved in launch services would be precluded from suing the passenger.

Likewise, the passenger would be precluded from suing the launch company and its contractors and subcontractors involved in launch services, as well as fellow passengers.

In most U.S. jurisdictions, the waiver would not preclude recovery by the passenger where the launch company or its contractors or subcontractors have acted with gross negligence, reckless disregard for the consequences of their actions, and/or willful misconduct.[6]

---

[1] 49 U.S.C. §§ 70101–70121 (2003).

[2] *Commercial Space Act of 2003,* H.R. 3245, 108th Cong. (introduced Oct. 2, 2003) ("H.R. 3245").

[3] *See id.* § 3(d)(2) (rewording some of the cross waiver provision, but making no mention of passengers).

[4] *See* 49 U.S.C. § 70112(b)(1) (requiring that the launch company "make a reciprocal waiver of claims with its contractors, subcontractors, and customers. . ."). *See also* 14 C.F.R. § 440.17 and Part 440, Appx. B, Agreement for Waiver of Claims and Assumption of Responsibility ("Waiver Agreement") (implementing the requirements in 49 U.S.C. § 70112(a)). The purpose of the cross waivers is: "(1) to limit the total universe of claims that might arise as a result of a launch; and (2) to eliminate the necessity for all these parties to obtain property and casualty insurance to protect against these claims." Commercial Space Launch Act Amendments of 1988, S. REP. NO. 100–593 (1988), at 14.

[5] H.R. 3245 § 2(6).

[6] *See, e.g., Martin Marietta Corp. v. International Telecomm. Satellite Org.,* 991 F.2d 94, 100 (4th Cir. 1992) (providing that "neither the language of the [CSLA] Amendments nor their legislative history reflects a Congressional intent to protect parties from liability for their own gross negligence"). In this case, Martin Marietta invoked a contractual waiver of liability to defend against INTELSAT's claims that Martin Marietta had been negligent and grossly negligent in failing to launch INTELSAT'S satellite into the correct orbit.

Passengers Without CSLA Waivers

If passengers are not required to sign reciprocal waivers, they could be sued by, e.g., the launch company and fellow passengers for negligence, gross negligence, reckless conduct, or willful misconduct under applicable U.S. state tort laws for any injury or damage they caused. A fellow passenger who is a foreign national may in addition be able to sue in a foreign country under foreign law. Note that the passenger's liability exposure could be significant in the early years of space travel as the passenger may have access to, or even be expected to oversee or operate, vehicle control interfaces and equipment.

Conversely, passengers would be able to sue the launch company and its contractors and subcontractors involved in launch services, as well as fellow passengers. Possible causes of action would include negligence, gross negligence, reckless conduct, or willful misconduct, as well as strict products liability with respect to the launch company. Breach of contract or breach of warranty would likely be precluded by protections in the contract between the launch company and the passenger.

Suits Against Passengers by "Third Parties" on the Ground

Passengers could be sued by third parties on the ground. Most likely, such a suit would be directed at the launch company, but could include the passenger as well. The launch company and passenger could be held liable for their negligence, gross negligence, reckless conduct, or willful misconduct. The launch company could in addition be held strictly liable on the theory that launch activity is "abnormally dangerous," as could conceivably the passenger if it were concluded he or she essentially acted as a pilot.[7] The suit would typically be brought in the state where the launch company resides or where the injury/damage occurred.

If injury or damage occurs in a foreign country, that country may bring a claim on behalf of a national who has suffered injury or damage against the United States under the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies[8] ("Outer Space Treaty") and the Convention on International Liability for Damage Caused by Space Objects[9] ("Liability Convention"), assuming that the foreign country is a party to these treaties. The Liability Convention imposes strict liability for any damage on the surface of the Earth.[10] The injured party may also claim directly under U.S. or foreign law, through U.S. or foreign courts.[11]

Launch companies licensed under the CSLA are required to obtain third party liability insurance in the amount determined by the Federal Aviation Administration's ("FAA") Associate Administrator for Commercial Space Transportation.[12] The specific coverage amount, which cannot exceed $500 million,[13] depends on the launch vehicle and launch location, but typically would be less than $200 million.

The CSLA requires that such insurance must protect the launch company and the satellite customer, as well as their respective contractors and subcontractors as additional insureds.[14] As H.R. 3245 is currently drafted, passengers would not be protected by the third party liability insurance.

Under the CSLA, launch companies and the satellite customer, as well as their respective contractors and subcontractors are entitled to indemnification in the event liability to third parties exceeds the insured amount, subject to certain condi-

---

[7] *See* RESTATEMENT (SECOND) OF TORTS § 519 (2003), which provides: (1) One who carries on an abnormally dangerous activity is subject to liability for harm to the person, land or chattels of another resulting from the activity, although he has exercised the utmost care to prevent the harm. (2) This strict liability is limited to the kind of harm, the possibility of which makes the activity abnormally dangerous. For example, according to the Restatement: any flight by aircraft, together with ascent to or descent from the flight, is activity of such character that both the operator of the aircraft and its owner if he has consented to or permitted the operation are subject to strict liability for physical harm to the land, or to persons or chattels on the ground. *Id.,* at § 520A. However, as far as flying is concerned, there is a trend away from imposing strict liability for damage on the ground, based on the view that flying has become routine and should no longer be considered "abnormally dangerous" activity. *See* William J. Appel, Annotation, *Strict Liability, in Absence of Statute, for Injury or Damage Occurring on the Ground Caused by Ascent, Descent, or Flight of Aircraft,* 73 A.L.R.4TH 416 (1989). This trend would likely not benefit launch activity.

[8] Outer Space Treaty, done Jan. 27, 1967, 18 U.S.T. 2410.

[9] Liability Convention, done Mar. 29, 1972, 24 U.S.T. 2389.

[10] *Id.,* art. XII.

[11] *See id.,* art. XI.2 (providing that "[n]othing in this Convention shall prevent a State, or natural or juridical persons it might represent, from pursuing a claim in the courts or administrative tribunals or agencies of a launching State").

[12] 49 U.S.C. § 70112(a)(2).

[13] *Id.* § 70112(a)(3).

[14] *Id.* § 70112(a)(4)(c).

tions.[15] The indemnification cap is $1.5 billion above the insured amount.[16] Under H.R. 3245, passengers are not entitled to such indemnification.

Suits Against Crew

Assuming crew are employees of the launch company, they are not required to sign waivers. Crew members nonetheless are offered some protection under the waiver, as the satellite customer and its contractors and subcontractors are prevented from bringing suit against launch company personnel. However, assuming crew members are contractors or subcontractors to the launch company, they are covered by the CSLA waiver and protected by the launch company's third party liability insurance, as well as USG Indemnification.

Q2. H.R. 3245 includes pre-qualification criteria for space flight participants, but none for crew members.

Q2a. Are the pre-qualification criteria listed for passengers in H.R. 3245 sufficient? Should criteria be added or deleted?

Q2b. Should the bill include pre-qualification criteria for crew members?

A2a.b. Pre-qualification criteria seem to be in order, especially given the proposed lack of focus in H.R. 3245 by the FAA on passenger safety. The pre-qualification standards must not be so severe as to stifle the development of the industry and frustrate the legislation's purpose to open space to the American people.

Pre-qualification Criteria for Passengers

H.R. 3245 proposes that:

> [t]he holder of a license under this chapter may launch or re-enter a space flight participant [i.e., passenger] only if—
>
> 1) the space flight participant has received training and met medical or other standards specified in the license[; and]
>
> 2) the space flight participant is informed of the safety record of the launch or re-entry vehicle type.. . .[17]

The adequacy of these criteria must be viewed in light of the regulatory focus proposed by the bill. H.R. 3245 states the FAA shall "focus on protecting the safety of the general, uninvolved public, while allowing involved persons to assume risks which are inherent to human space flight activities."[18] In other words, the FAA will not be required, or permitted, to regulate the safety of passengers onboard the vehicle, but only the safety of the general public.

With this proposal, the FAA will not examine or regulate safety of the passenger compartment. Essentially, what happens to the passenger onboard the vehicle is not an issue for the FAA. For example, the FAA will not examine whether the levels of noise, vibration, temperature or toxic fumes are suitable for human exposure. *Accordingly, if the passenger returns to Earth deceased as a result of toxic fumes in the passenger compartment, the FAA will have successfully carried out its safety mandate, assuming there is no incident to the general public.*

Is this sound public policy? Is it acceptable in today's society that a regulatory agency turn a blind eye to the safety of persons engaged in the regulated activity? While this is the FAA's approach to satellite payloads—the FAA is not concerned with "mission success"—it may not be suitable for passengers. First, satellite customers are better equipped to scrutinize the launch environment than most passengers. Second, how can one compare a lost life to a lost satellite?

If a "hands-off" regulatory approach to passenger safety nonetheless is adopted, passenger qualification, training, and informed consent become all the more critical. Not only are the legislative criteria important, but their careful and considered implementation and enforcement is key. YET, THE CRITERIA CANNOT BE SO STRINGENT AS TO FRUSTRATE THE VERY PURPOSE THE BILL IS INTENDED TO PROMOTE, NAMELY "THE OPENING OF OUTER SPACE TO THE AMERICAN PEOPLE,"[19] THAT IS, THE PUBLIC AT LARGE.

Pre-qualification Criteria for Crew

The carrier would have a business interest in ensuring that the crew is properly qualified and trained. The FAA would have the authority to review crew qualifica-

---

[15] *Id.* § 70113.
[16] *Id.* § 70113 (a)(1)(B).
[17] H.R. 3245 § (3)(d)(1)(B).
[18] *Id.* § 2(6).
[19] *Id.* § 2(3).

tions under its mandate to ensure public safety.[20] It currently does so in connection with launches of satellite payloads. If the FAA's authority is extended to cover passenger safety, crew qualification should be similarly extended.

Q3. Should passengers be considered "third parties" who could seek damages from the licensee in the case of an accident? What are the benefits and drawbacks of such an arrangement?

Q3a. Should the licensee be required to indemnify the passenger through limited "carrier" liability as additional insured?

Q3b. Should passengers be entitled to indemnification against claims that may be made against them by third parties?

A3a,b. The term "third party" has a particular meaning within the CSLA regime. Merely making the passenger a "third party" does not solve the problem. Applying the same regime to passengers as is today applied to satellite customers is one possible approach. That includes waivers, third party liability insurance protection, and USG Indemnification. Alternative approaches should also be considered, including waivers combined with "carrier" indemnification of the passenger against third party liability. Partial waivers are also possible, e.g., where the passenger is permitted to sue the launch company and its contractors and subcontractors, but not the fellow passengers or crew.

Significance of "Third Party" Designation Under CSLA

The CSLA currently establishes a regime whereby it distinguishes between: 1) persons who are "involved in launch services;" and 2) third parties. The first group includes the licensee, i.e., the launch company and its contractors and subcontractors; the satellite customer and its contractors and subcontractors; and the U.S. Government and its contractors and subcontractors, involved in launch services or re-entry services. Third parties are defined as any party other than those included in the first group.[21]

These two groups are subjected to different treatment. Those in the first group are:

- required to sign liability waivers;[22]
- protected by third party liability insurance that the launch company is required to obtain;[23] and
- with the exception of the U.S. Government and its contractor and subcontractors, entitled to USG Indemnification for third party liability subject to the conditions spelled out in the CSLA.[24]

As a general rule, third parties may bring suit against any party, and they are not protected by the launch company's third party liability insurance[25] or by USG Indemnification.

Passengers as Third Parties Under CSLA

If passengers are considered "third parties" under CSLA, they would not be required to sign waivers; they would not be protected by the launch company's third party liability insurance against suits from other third parties; and they would not be entitled to USG Indemnification.

The result would be that the passenger could get sued by the launch company and its contractors and subcontractors and fellow passengers. At the same time, the passenger would be entitled to sue the launch company and its contractors and subcontractors for injury or damage it suffers.

A passenger with third party status under the CSLA could also be sued by other third parties. The passenger would not then have the benefit of the launch company's third party liability insurance or USG Indemnification. However, the passenger would be entitled to seek indemnification from the launch company and its contractors and subcontractors, if these were the parties that caused the injury or damage. Whether the passenger would be successful is another matter.

---

[20] 49 U.S.C. § 70105(b).

[21] *Id.* § 70102(16). Note, however, that U.S. Government employees are also considered third parties. 14 C.F.R. § 440.3(a)(15)(ii).

[22] 49 U.S.C. § 70112(b).

[23] *Id.* § 70112(a)(3).

[24] *Id.* § 70113(a)(1).

[25] An exception exists for U.S. Government employees, who are considered third parties. *Id.* § 70112(a)(4). *See supra* note 21 (considering U.S. Government employees as third parties).

Treating Passengers Like Satellite Customers Is a Possibility

If passengers were treated like satellite customers under the CSLA, they would be required to sign waivers; they would be protected by the launch company's third party liability insurance against suits from third parties; and they would be entitled to USG Indemnification.

Creatine Alternative Passenger Protection Under H.R. 3245

It is possible to design an alternative risk allocation and liability protection scheme for passengers. Several variations are possible:

- *Waiver and Carrier Indemnification*

  One possibility is to combine a CSLA waiver with mandated launch company indemnification for third party liability.

  - The CSLA waiver would preclude: 1) the passenger from suing the launch company and its contractors and subcontractors and fellow passenger for injury and property damage; and 2) the launch company and its contractors and subcontractors and fellow passengers from suing the passenger.
  - The passenger would be entitled to mandated contractual indemnification by the launch company from and against third party liability. This could be in the form of a legislative requirement to indemnify, hold harmless, and defend the passenger from and against any third party claims, suit, or liability the passenger may be subjected to as a result of space travel activities. This requirement could be accompanied by a requirement that the launch company name the passenger an additional insured under the third party liability insurance that the launch company is required to take out under 49 U.S.C. § 70112(a). This model would not include USG Indemnification of the passenger.[26]

- *Limited Waiver by the Passenger and Carrier Liability With Cap*

  Another possibility is to allow the passenger to sue the launch company and its contractors and subcontractors but not its fellow passengers. This could be coupled with a prohibition on suits against the passenger by the launch company and its contractors and subcontractors and fellow passengers. As for third party liability, either the model applicable to satellite customers or the model discussed immediately above could be used.

USG Indemnification of the Licensee/Carrier

In any event, USG Indemnification should apply to the company operating the vehicle for human space flight. This is consistent with the treatment of expendable launch vehicle companies in the U.S. and around the world.

Questions submitted by Representative Bart Gordon

Q1. Section 4 of H.R. 3245 includes a provision that says:

> *"The Secretary of Transportation shall. . .focus the Department's regulation of commercial human space flight activities on protecting the safety of the general public, while allowing space flight participants who have been trained and meet license-specific standards to assume an informed level of risk."*

Q1a. That language would appear to preclude DOT from regulating passenger safety on commercial passenger-carrying spacecraft. Do you consider that to be an appropriate public policy? Why or why not?

Q1b. If you think that DOT should not regulate passenger safety at the present time, is there any point in the future when the government should become involved in such regulation?

A1a,b.

I agree that the quoted bill language directs the FAA to focus on the safety of the general public to the exclusion of the passenger. I am concerned that this approval may not be sound public policy. Is it acceptable in today's society for a regulatory agency to turn a blind eye to the safety of persons engaged in regulated activity? Moreover, could the very purpose that the bill is trying to serve—namely "the

[26] Depending on the circumstances and the interpretation of 49 U.S.C. § 70113, the USG Indemnification available to the launch company might cover the launch company for its indemnification of the passenger.

opening of outer space to the American people"—be frustrated if an accident were to happen, as it would have a chilling effect on further human space flight.

Under H.R. 3245, the FAA will not have the mandate to examine or regulate safety of the passenger, including the passenger compartment. The passenger's safety would simply not be an issue for the FAA. For example, the FAA would not examine whether the levels of noise, vibration, toxic fumes, or temperature are suitable for human exposure. That decision would be left to the vehicle operator and the passenger. Accordingly, if the passenger returns to Earth dead as a result of toxic fumes in the passenger compartment, the FAA would have carried out its safety mandate successfully, assuming there is no incident to the general public.

While this is the FAA's approach to satellite payloads under the CSLA—the FAA is not concerned with "mission success"—it may not be suitable for passengers. Satellite customers are better equipped to scrutinize the launch environment than most passengers. Furthermore, how can one compare a lost life to a lost satellite?

Some FAA evaluation and regulation to ensure passenger safety may be in order. HOWEVER, THAT REGULATION MUST BE MINIMAL SO AS NOT TO STIFLE THE DEVELOPMENT OF A NASCENT INDUSTRY. Furthermore, the regulation must be balanced against the medical and training criteria imposed on the passenger, For example, a healthy and fit person who is trained will likely have a higher tolerance for certain conditions in the passenger compartment than a person without such physical fitness and training.

Q2. What information do you believe a commercial human space flight company would have to provide to allow a potential passenger to give his or her "informed consent"? For example, what constitutes sufficient information on a vehicle's safety record, if the vehicle has only flown a statistically insignificant number of times?

A2. H.R. 3245 requires that a "space flight participant [be] informed of the safety record of the launch or re-entry vehicle type."[27]

Your question suggests—and clearly this will be the case—that the passenger will not have a statistical basis upon which to make an informed decision on vehicle safety. Assuming the passenger is not a flight safety engineer or otherwise able to make a professional evaluation of passenger safety, the informed consent becomes meaningless. Rather, the consent takes the character of an assumption of risk. On the other hand, if the FAA could undertake some measure of passenger safety evaluation, the passenger could make an informed decision based on the agency's findings. The approach chosen by H.R. 3245 presupposes that the launch company will have sufficient economic and business incentive to ensure passenger safety.

Passengers should have access to the launch license application filed with the FAA. The CSLA requires launch companies to submit an application to the FAA prior to launch.[28] The FAA evaluates the application to determine whether the launch is "[c]onsistent with the public heath and safety, safety of property, and national security and foreign policy interests of the United States.. . ."[29] Again, the FAA's safety focus is currently on the general public, not the satellite payload. Likewise, under H.R. 3245, the safety focus would be on the general public to the exclusion of the passenger.

Q3. H.R. 3245 says that a license holder may launch a paying passenger into space only if "the space flight participant has received training and met medical or other standards specified in the license."

Q3a. Do you agree with the provision?

Q3b. Who should set the standards and determine the appropriate level of training?

Q3c. Who would certify that the training had been done?

Q3d. Should the specified standards be uniform across the industry? If not, how would you make it work in practice?

A3a,b,c,d. Some medical and training criteria may be in order in the beginning years of commercial human space flight, as such flight is likely to involve certain physical rigors and to require some measure of cooperation by the passengers.

It would make sense to have the same regulatory agency that licenses the launch also set the medical and training qualification standards. The launch operator could certify that the training had been done. The certification should be subject to FAA oversight. From a regulatory perspective, uniform standards make sense. However,

[27] H.R. 3245 § 3(d)(1)(B).
[28] 49 U.S.C. § 70105(a)(1).
[29] *Id.*

given the infancy of the industry and the variety of vehicles being proposed, some vehicle flights may warrant additional passenger training and physical fitness criteria.

Q4. Would the cross-waivers of liability against death or personal injury of a passenger contained in H.R. 3245 still hold if there were allegations of negligence?

A4. As presently drafted, H.R. 3245 does not provide for a waiver of liability with respect to passengers. See answer to Chairman Rohrabacher's Question No. 1.

In most U.S. jurisdictions, the waiver would not preclude recovery by the passenger where the launch company or its contractors or subcontractors have acted with gross negligence, reckless disregard for the consequences of their actions, or willful misconduct.[30]

Q5. Section 70104 of Title 49 of the U.S. Code states that a U.S. company planning to launch a launch vehicle or re-enter a re-entry vehicle outside of the United States will need to get a license.

Q5a. If the U.S. Code is expanded to cover commercial human space flight activities, would a U.S. company that was offering rides on the Russian Soyuz spacecraft in a partnership with a Russian company need to get a license from the U.S. Department of Transportation? If not, why not?

Q5b. If so, how would DOT enforce the terms of the license?

A5a,b. The CSLA provides for U.S. licensing in the following circumstances:

- launches from or re-entries in the U.S.;
- launches and re-entries anywhere by U.S. citizens and U.S. entities;
- launches or re-entries by U.S.-controlled entities on the high seas, *unless* there is an agreement between the U.S. and a foreign country that the foreign country shall have jurisdiction; and
- launches or re-entries by a U.S. controlled entity in a foreign country, *if* there is an agreement between the U.S. and the foreign country that the U.S. shall have jurisdiction.[31]

Assuming, the U.S. company and the Russian company have created a partnership or joint venture company to actually conduct the launch in Russia and the partnership/venture is U.S.-controlled, then the FAA will not license the venture unless there is an agreement between Russia and the U.S. that the FAA will license the venture.[32]

If, however, the launch or re-entry were to take place in the United States, an FAA license would be required.

The venture or partnership between Lockheed Martin and the Russian companies Energia and Khrunichev to launch satellites on the Proton rocket from Baikonur, Kazakhstan, does not to my knowledge require a license from the FAA. On the other hand, the partnership of Boeing and Russian, Ukrainian, and Norwegian companies—Sea Launch—to launch from the high seas is licensed by the FAA.

[30] *See supra* note 6.
[31] 49 U.S.C. § 70104.
[32] *Id.* § 70104(a)(4).

Appendix 2:

Additional Material for the Record

I

108TH CONGRESS
1ST SESSION

H. R. 3245

To promote the development of the commercial space transportation industry, to authorize appropriations for the Office of the Associate Administrator for Commercial Space Transportation, to authorize appropriations for the Office of Space Commerce, and for other purposes.

IN THE HOUSE OF REPRESENTATIVES

OCTOBER 2, 2003

Mr. ROHRABACHER (for himself, Mr. GORDON, and Mr. HALL) introduced the following bill; which was referred to the Committee on Science

---

A BILL

To promote the development of the commercial space transportation industry, to authorize appropriations for the Office of the Associate Administrator for Commercial Space Transportation, to authorize appropriations for the Office of Space Commerce, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the "Commercial Space Act of 2003".

SEC. 2. FINDINGS.

The Congress finds that—

1 (1) a prolonged and severe downturn in the
2 market for commercial space launches has resulted
3 in—
4 (A) a significant reduction in the United
5 States global market share in orbital space
6 launches;
7 (B) a severe decrease in the number of
8 Government-licensed orbital launches; and
9 (C) a commercial space transportation in-
10 dustry dependent upon Government business
11 opportunities;
12 (2) the continuous reduction of cost and im-
13 provement in safety and reliability of commercial
14 space transportation capabilities is a necessary in-
15 gredient to achieving most United States space
16 goals;
17 (3) the opening of outer space to the American
18 people and their economic, scientific, and cultural
19 enterprises is a priority goal which should guide
20 Federal space investments, policy development, and
21 regulatory action;
22 (4) despite a weak United States launch indus-
23 try, recent industrial and technical developments in-
24 dicate that commercial suborbital human spaceflight
25 vehicles are under active development in both the

1 United States and other nations, and greater private
2 investment in these development efforts will promote
3 greater innovation and competitiveness for the
4 United States commercial space transportation in-
5 dustry as a whole;
6 (5) space transportation is not without risks;
7 (6) a critical area of responsibility for the Of-
8 fice of the Associate Administrator for Commercial
9 Space Transportation is to ensure that the Federal
10 regulation of this new commercial suborbital human
11 spaceflight industry should focus on protecting the
12 safety of the general, uninvolved public, while allow-
13 ing involved persons to assume risks which are in-
14 herent to human spaceflight activities;
15 (7) enactment of a 3-year extension of the ex-
16 cess third party claims payment provision of chapter
17 701 of title 49, United States Code (Commercial
18 Space Launch Activities) is necessary to provide an
19 appropriate period to evaluate recommended changes
20 to the Government's commercial space launch in-
21 demnification regime;
22 (8) the Secretary of Transportation should es-
23 tablish regulatory guidelines that foster an efficient
24 and cost-effective process for ensuring safe commer-

1 cial space launch operations at the Nation's launch
2 ranges and bases; and
3 (9) the public interest is served by creating a
4 clear legal and regulatory regime for commercial
5 space transportation, including an unambiguous de-
6 lineation of regulatory roles and responsibilities.

7 **SEC. 3. AMENDMENTS.**

8 (a) AUTHORIZATION OF APPROPRIATIONS FOR OF-
9 FICE OF COMMERCIAL SPACE TRANSPORTATION.—Sec-
10 tion 70119 of title 49, United States Code, is amended
11 by striking paragraphs (1) and (2) and inserting the fol-
12 lowing:
13 "(1) $11,523,000 for fiscal year 2004; and
14 "(2) $11,000,000 for fiscal year 2005.".
15 (b) FINDINGS.—Section 70101(a) of title 49, United
16 States Code, is amended—
17 (1) in paragraph (3), by inserting "human
18 spaceflight," after "research,"; and
19 (2) in paragraph (4), by striking "satellite" and
20 inserting "space", and by striking "services now
21 available from" and inserting "capabilities of".
22 (c) DEFINITIONS.—Section 70102 of title 49, United
23 States Code, is amended—
24 (1) by redesignating paragraphs (2) through
25 (16) as paragraphs (3), (4), (5), (6), (7), (8), (9),

(10), (11), (12), (13), (14), (16), (19), and (20), respectively;

(2) by inserting after paragraph (1) the following new paragraph:

"(2) 'crew' means an individual or individuals carried within a launch or reentry vehicle who performs a function necessary for the protection of public safety. ";

(3) in paragraph (9), as so redesignated by paragraph (1) of this subsection—

(A) by inserting "an individual or" after "means";

(B) by inserting "or return from" after "to place in"; and

(C) by striking "that object" and inserting "that individual or object";

(4) by inserting after paragraph (14), as so redesignated by paragraph (1) of this subsection, the following new paragraph:

"(15) 'spaceflight participant' means an individual who is not crew carried within a launch or reentry vehicle during a launch or reentry.";

(5) by inserting after paragraph (16), as so redesignated by paragraph (1) of this subsection, the following new paragraphs:

"(17) 'suborbital rocket' means a rocket-propelled vehicle intended for flight on a suborbital trajectory whose thrust is greater than its lift for the majority of the powered portion of its flight.

"(18) 'suborbital trajectory' means the intentional flight path of a launch vehicle, reentry vehicle, or any portion thereof, whose vacuum instantaneous impact point does not leave the surface of the Earth."; and

(6) in paragraph (19), as so redesignated by paragraph (1) of this subsection—

(A) by striking "or" at the end of subparagraph (C);

(B) by striking the period at the end of subparagraph (D) and inserting "; and"; and

(C) by adding at the end the following new subparagraph:

"(E) crew or spaceflight participants.".

(d) COMMERCIAL HUMAN SPACEFLIGHT.—(1) Section 70104 of title 49, United States Code, is amended—

(A) by redesignating subsection (c) as subsection (d); and

(B) by inserting after subsection (b) the following new subsection:

"(c) COMPLIANCE WITH SPACEFLIGHT PARTICIPANT REQUIREMENTS.—The holder of a license under this chapter may launch or reenter a spaceflight participant only if—

"(1) the spaceflight participant has received training and met medical or other standards specified in the license;

"(2) the spaceflight participant is informed of the safety record of the launch or reentry vehicle type; and

"(3) the launch or reentry vehicle is marked in a manner specified by the Secretary of Transportation which identifies it as a launch or reentry vehicle rather than an aircraft.".

(2) Section 70112(b)(1) of title 49, United States Code, is amended by striking "property damage or loss it sustains, or for personal injury to, death of, or property damage or loss sustained by its own employees" and inserting "personal injury, death, property damage, or loss it sustains, and for personal injury to, death of, or property damage or loss sustained by its own employees,".

SEC. 4. REGULATORY FRAMEWORK.

The Secretary of Transportation shall take appropriate efforts, including realignment of personnel and resources, to create a streamlined, cost-effective, and ena-

1 bling regulatory framework for the United States commer-
2 cial human spaceflight industry. The Secretary of Trans-
3 portation shall clearly distinguish the Department's regu-
4 lation of air commerce from its regulation of commercial
5 human spaceflight, and focus the Department's regulation
6 of commercial human spaceflight activities on protecting
7 the safety of the general public, while allowing spaceflight
8 participants who have been trained and meet license-spe-
9 cific standards to assume an informed level of risk. Not
10 later than 6 months after the date of enactment of this
11 Act, the Secretary of Transportation shall transmit to the
12 Congress a report on the progress made in implementing
13 this section.

14 **SEC. 5. COMMERCIAL SPACE TRANSPORTATION INDEM-**
15 **NIFICATION EXTENSION.**

16 Section 70113(f) of title 49, United States Code, is
17 amended by striking "December 31, 2004" and inserting
18 "December 31, 2007".

19 **SEC. 6. LIABILITY REGIME FOR COMMERCIAL SPACE**
20 **TRANSPORTATION.**

21 (a) APPLICATIONS.—Not later than 60 days after the
22 date of the enactment of this Act, the Secretary of Trans-
23 portation shall enter into an appropriate arrangement
24 with the National Academy of Public Administration to
25 conduct a study on the liability risk-sharing regime in the

1 United States for commercial space transportation. The
2 study shall recommend modifications to the liability re-
3 gime and characterization of actions required to imple-
4 ment those modifications. The study shall analyze the ade-
5 quacy, propriety, and effectiveness of, and the need for,
6 the current liability risk-sharing regime. The study shall
7 specifically consider—
8 (1) other countries' regimes;
9 (2) the use of the designation of "ultra haz-
10 ardous" for space transportation activities;
11 (3) relevant international treaties;
12 (4) impacts of reusable launch vehicles and
13 spaceports; and
14 (5) the feasibility of airline-like liability re-
15 gimes.
16 The study shall use a clearly described, analytical method-
17 ology to specify the factors used in evaluating the current
18 regime and alternative approaches to the current regime.
19 Estimates of impacts shall be quantified where possible.
20 (b) COMPLETION DATE.—The results of the study
21 described in subsection (a) shall be transmitted to the
22 Congress not later than 18 months after the date of the
23 enactment of this Act.

1 **SEC. 7. OFFICE OF SPACE COMMERCE.**

2 (a) REDESIGNATION.—The Office of Space Commer-
3 cialization established under section 8 of the Technology
4 Administration Act of 1998 (15 U.S.C. 1511e) is redesig-
5 nated as the Office of Space Commerce.

6 (b) AUTHORIZATION OF APPROPRIATIONS.—There
7 are authorized to be appropriated to the Secretary of Com-
8 merce for the Office of Space Commerce—

9 (1) $1,800,000 for fiscal year 2004; and

10 (2) $2,000,000 for fiscal year 2005.

11 **SEC. 8. DELEGATION OF LICENSING AUTHORITY.**

12 (a) DELEGATION.—The Secretary of Commerce shall
13 delegate the authority provided to the Secretary under
14 title II of the Land Remote Sensing Policy Act of 1992
15 (15 U.S.C. 5621 et seq.) to the Director of the Office of
16 Space Commerce.

17 (b) AMENDMENT.—Section 8(c) of the Technology
18 Administration Act of 1998 (15 U.S.C. 1511e(c)) is
19 amended—

20 (1) by striking "and" at the end of paragraph
21 (6);

22 (2) by striking the period at the end of para-
23 graph (7) and inserting a semicolon; and

24 (3) by adding at the end the following:

25 "(8) licensing private sector parties to operate
26 private remote sensing space systems; and

1 "(9) serving as the Executive Secretary for the
2 Interagency Global Positioning System Executive
3 Board.".

○

SECTIONAL ANALYSIS OF H.R. 3245

Summary of the "Commercial Space Act of 2003"

The bill clarifies the regulatory framework for commercial human space flight. The bill extends the existing commercial space transportation indemnification regime by three years, through December 31, 2007, and mandates a study on the liability risk-sharing regime for commercial space transportation. The bill specifies that the licensing authority for private-sector remote sensing systems within the Commerce Department be delegated to the Office of Space Commerce. The bill authorizes to be appropriated $11,523,000 and $11,000,000 for fiscal years 2004 and 2005, respectively, for the FAA Office of Commercial Space Transportation. The bill also authorizes to be appropriated $1,800,000 and $2,000,000 for fiscal years 2004 and 2005, respectively, for the Department of Commerce's Office of Space Commerce.

Section 1. Short Title.

Section 2. Findings.

This section makes certain findings regarding the U.S. commercial space transportation industry and commercial sub-orbital human space flight in general.

Section 3. Amendments.

This section authorizes to be appropriated $11,523,000 and $11,000,000 for FY 2004 and FY 2005, respectively, for the FAA Office of Commercial Space Transportation. The bill amends the Commercial Space Launch Activities Act (Title 49, U.S.C., Subtitle IX, Chapter 701) to clarify the regulatory purview of the FAA Office of Commercial Space Transportation to include licensing of commercial human space flight by defining certain terms relevant to commercial human space flight. These terms include the following: crew, space flight participant, sub-orbital rocket, and sub-orbital trajectory.

This section directs that the holder of a commercial human space flight license may launch or re-enter a space flight participant only if the participant has received training and met medical or other standards specified in the license, the participant is informed of the safety record of the launch or re-entry vehicle type, and the launch or re-entry vehicle is marked in a manner to identify it as a launch or re-entry vehicle rather than an aircraft. This section also includes a provision requiring a reciprocal waiver of liability claims between the holder of a license, its contractors, subcontractors, and its customers ("space flight participants").

Section 4. Regulatory Framework.

This section directs the Secretary of Transportation to undertake efforts to create a streamlined, cost-effective, and enabling regulatory framework for the U.S. commercial human space flight industry that is clearly distinguished from the Transportation Department's regulation of air commerce, focuses its regulation of commercial human space flight on protecting the safety of the general public, and allows space flight participants who are trained and meet license-specific standards to assume an informed level of risk. The Secretary is directed to report to Congress within six months after the date of enactment of this bill on progress made in implementing this section.

Section 5. Commercial Space Transportation Indemnification Extension.

This section amends existing law by extending the existing commercial space launch indemnification regime by three years, through December 31, 2007.

Section 6. Liability Regime for Commercial Space Transportation.

This section directs the Secretary of Transportation to enter into an arrangement with the National Academy of Public Administration (NAPA) not later than 60 days after enactment of this bill to conduct a study on the liability risk-sharing regime in the United States for commercial space transportation. The study shall recommend modifications and actions required for alternative approaches to the current liability risk-sharing regime. The study results shall be transmitted to the Congress not later than 18 months after enactment of this bill.

Section 7. Office of Space Commerce.

This section redesignates the Office of Space Commercialization as the Office of Space Commerce. The section also authorizes the appropriation of $1,800,000 for FY 2004 and $2,000,000 for FY 2005 for the Office of Space Commerce.

Section 8. Delegation of Licensing Authority.

This section requires the Secretary of Commerce to delegate the authority to license private-sector remote sensing space systems operators provided under current law to the Director of the Office of Space Commerce. This section also amends current law by adding additional functions and duties to the Office of Space Commerce.

PREPARED STATEMENT OF JAMES A.M. MUNCY

Preface

I very much appreciate the opportunity to present my views on H.R. 3245, the *Commercial Space Act of 2003.* To make this testimony as useful as possible for Members and staff, I have structured it in the form of a "Frequently Asked Questions" document, essentially a tutorial on the issues underlying the legislation along with my recommended positions on those issues. I have also attached a copy of my recent *Space News* column as further background.

What's the historical context for this legislation?

When the Congress crafted the *Commercial Space Launch Act of 1984,* it demonstrated bipartisan foresight in promoting the emergence of a now-vital commercial space transportation industry. For two decades, the role and capabilities of that industry have grown to encompass the launch of nearly all military and civilian spacecraft as well as many commercial satellites. While only commercial launches by U.S. providers are licensed by the Department of Transportation, the CSLA's creation of a streamlined, "one stop shop" to regulate and promote the industry has enabled it to serve public as well as private interests. From time to time, the Congress has amended the CSLA to add new statutory authority or clarify the mission of the Office of Commercial Space Transportation (OCST) based on new industrial, technological or policy developments.

Today, the nascent sub-orbital reusable launch vehicle (RLV) industry seeks to pioneer new commercial human space flight market opportunities, as well as offer microgravity research, remote sensing/surveillance, and micro-satellite launch services.

So will OCST will regulate and promote these new RLVs?

Unfortunately, in 1995 the previous Administration transferred the OCST into the Federal Aviation Administration, a much larger and, by all accounts, more bureaucratically conservative organization. Coincidentally, Congress had removed the FAA's promotional authority regarding commercial aviation in 1996. This confluence of events, along with a lack of clear definitions for important terms in the original CSLA ('sub-orbital rocket' and 'sub-orbital trajectory') has created some confusion over regulatory jurisdiction within the FAA, which in turn has hindered private investment in the sub-orbital RLV industry.

On July 24, 2003, a joint hearing before the Senate Subcommittee on Science, Technology and Space and the House Subcommittee on Space & Aeronautics featured strong and unanimous testimony that this jurisdictional issue should be resolved by legislation that would define key terms and restore the sole authority of the Office of Commercial Space Transportation to regulate and promote this industry.

It is this need to create a predictable and enabling business environment for the emerging U.S. sub-orbital RLV industry that calls for enactment of the *Commercial Space Act of 2003.*

Is this all just about space tourism?

No. While sub-orbital RLVs do not, by definition, fly all the way into Earth orbit like the Space Shuttle, they can provide a scientific experiment with a few minutes of microgravity time or an environmental sensor with a high enough altitude to collect timely data over a large region. Furthermore, using low-cost expendable upper stages, sub-orbital RLVs can provide affordable launch services for small (<250 kg) satellites or scientific probes, a class of spacecraft that universities can often afford to build but not launch.

That said, travel and tourism is one of America's largest industries, and the adventure travel market is its fastest growing sector. If we have learned anything from the few successes and many failures of "space commercialization," it is that we need to identify and promote space activities which have a large terrestrial market. Communications satellites paid off because there was a pre-existing demand for long-distance communications, which then continued to grow as space technology lowered prices and improved quality. Direct broadcast satellites are paying off because there is a preexisting demand for affordable and diverse entertainment and information. So too, expanding America's adventure travel industry into space will tap into a pent-up market demand, thus winning significant private investments in sub-orbital RLVs.

Of course, the benefits of giving more Americans the opportunity to experience space flight go well beyond new jobs and profits. As the public reaction to Dennis Tito's 2001 flight to the International Space Station proved, the American people believe that they too have "the right stuff" and might one day be able to fly into space,

even if they choose not to. The more real this opportunity becomes, the more children will be inspired to study math and science so they can participate in this exciting future.

If NASA can't build a new RLV. . .how can entrepreneurs?

The cost and difficulty of developing a heavy-lift (i.e., Shuttle-class) RLV that could carry astronauts, modules, or large satellites into space is indeed daunting. NASA's own estimates for a 2nd Generation RLV ran over $30 billion before that program's cancellation in 2002.

Furthermore, the limited market for launching satellites is not encouraging large orbital RLV development today because the demand for those launch services cannot grow quickly enough to repay investors for the high costs of developing orbital RLVs. That is one of the tragic mistakes of NASA's RLV development efforts over the past decade: assuming that commercial industry would invest in a capability it cannot financially justify simply because NASA wants to get that capability on the cheap. (The other mistake is the assumption that better technology will somehow overcome this economic reality.)

On the other hand, sub-orbital RLVs are smaller, simpler, easier, and (therefore) much cheaper to develop. And unlike satellite launch, the space adventure travel market does appear to be large enough to justify these much-lower development costs. Of course, sub-orbital RLVs can't solve NASA's real and pressing space transportation problems today, or anytime soon.

But one day these vehicles and markets may grow up and enable a true revolution in access to orbital space, much as home-built personal computers eventually displaced the "mainframes" of the old 1970's data processing industry.

How should the Federal Government regulate sub-orbital RLVs?

Answer #1: Moderately, and primarily to protect the uninvolved general public, while allowing investors and adventure-seeking customers to take informed risks so the industry can "grow up."

Answer #2: Not at all like it regulates commercial aviation, which is a mature, well-established industry that provides commodity transportation services for the general public.

Answer #3: Not exactly the way it regulates the current expendable launch vehicle (ELV) industry either, because sub-orbital RLVs aren't as big or potentially destructive as ELVs, they will become inherently more reliable via reusability, and—of course—they will carry human beings and not just satellites as payloads.

What part of the Federal Government should regulate sub-orbital RLVs?

As is so often the case, who you give the job to will determine how well the job gets done. This is the key issue H.R. 3425 seeks to answer. While some proposed sub-orbital RLVs look every bit like a Goddard, Heinlein, or Von Braun rocket, others look a lot like airplanes. They may have wings, use aerodynamic lift during their flight profiles, and even take off and land horizontally at runways. But they are not at all conventional aircraft, and must not be regulated as if they were.

American aviation will celebrate 100 years of success next month. The level of safety we enjoy today is not simply the result of tough regulation but rather that regulation enforces safety-promoting best practices that have evolved over time based on real-world experiences from millions of flights. Of course, the FAA has built up a very large bureaucracy over this time in order to carry out its regulatory duties: some 50,000 employees. In 1996 the Congress even took away the FAA's job of "promoting" aviation so it could focus on doing its regulatory and airspace management jobs more effectively, allowing more passengers to fly more places more safely and affordably.

All of these facts disqualify the aviation side of the FAA from providing the modest, enabling regulatory framework that the sub-orbital RLV industry needs during its formative years.

But isn't the FAA in charge of regulating launch vehicles too?

Yes, and that is an Executive Branch mistake Congress should fix. The Commercial Space Launch Act created a separate Office of Commercial Space Transportation reporting directly to the Secretary. A misguided attempt to "flatten" government in 1995 ended up transferring OCST into the very organization the CSLA's sponsors never wanted involved in regulating space transportation, namely the FAA. OCST is now the Office of the FAA Associate Administrator for Commercial Space Transportation, but this 50-person office's de jure independence is de facto circumscribed by living inside a 50,000 person bureaucracy. To be sure, there may be some unplanned synergies or efficiencies made possible by this situation, but

those have been demonstrably overwhelmed by the legal, bureaucratic, and cultural barriers to effective action this reorganization created.

As witnesses testified on July 24th, the mere *possibility* that a sub-orbital RLV company might have to win regulatory approval of both the aviation and space launch sides of the FAA has already delayed or prevented private investment in this industry.

How can Congress fix this confusion?

First and foremost, the Congress needs to confirm its original intent in enacting the CSLA. All commercial space transportation ventures—including sub-orbital RLVs carrying human space flight participants—should be regulated by one organization that also has the mandate (and temperament) to promote the growth and competitiveness of the industry as a whole.

Enacting into law the FAA's recently-published definitions of "sub-orbital rocket" and "sub-orbital trajectory" will give clear regulatory jurisdiction to the FAA's Associate Administrator for Commercial Space Transportation. Those (and other useful) definitions are already contained in H.R. 3245, and must be preserved in the final enacted legislation.

Do any RLV companies prefer the aviation side of FAA to the space side?

No. One funded RLV developer has loudly complained that he should be allowed to fly a sub-orbital RLV as easily as he has flown earlier experimental aircraft, i.e., with minimal government oversight. However, he has applied for a launch license. No credible industry official claims it would be easier to obtain commercial aircraft type certification for revenue-earning operations carrying space flight participants than it would be to get a launch license.

So are experimental aircraft rules easier for flight-testing of RLVs?

They may be easier to get than a launch license, but they don't allow for the kind of flight profile even early sub-orbital RLVs will display. For one thing, RLVs will fly faster than the speed of sound, and eventually at hypersonic speeds. FAA environmental rules do not allow experimental aircraft to do so without a special waiver.

More importantly, the legal regimes under which aircraft and spacecraft operate are completely different. The Warsaw Convention limits private and public liability for aviation accidents. The U.N.'s Space Liability Convention makes the "launching state" (i.e., government) wholly liable for damage caused by any space object. Should the U.S. government allow a private RLV developer to incur international liability for taxpayers without having to obtain a federal launch license?

(See also my attached October 27, 2003, *Space News* column.)

What about expertise in regulating passenger flights?

Some inside the FAA's Office of Regulation and Certification (FAA/AVR), which oversees airplanes and airlines, have said they should have a role in licensing of passenger-carrying RLV flights, because only they have expertise in passenger regulation. This is precisely the sort of regulatory confusion that stifles private investment in sub-orbital RLVs.

Actually, the only governmental organizations with experience in regulating human space flight are NASA, Russia's Rosaviacosmos, and the emergent Chinese space program. And the only nation with expertise in commercial human space flight is Russia. So FAA/AVR has no claim to *relevant* expertise.

Obviously, the federal role in sub-orbital RLV flights carrying space flight participants cannot be as *laissez-faire* as the wholly unregulated days of airplane barnstorming. However, OCST (also known as FAA/AST) is perfectly capable of working with industry to set license-specific standards for training and medical qualification, as called for in H.R. 3245. AST does not need AVR looking over its shoulder.

What's this "indemnification" thing, anyways?

Because the U.S. government and rocket companies are both liable under international law for damages caused by a space transportation accident, the Congress created a risk-sharing regime for so-called "excess third party claims" in its 1988 amendments to the CSLA. Usually referred to as indemnification, the regime provides for the following mutual protection. First, industry has to buy liability insurance or demonstrate financial resources to pay the "maximum probable loss" (MPL) from a licensed launch or re-entry activity, and to use this coverage to protect the Federal Government from its legal exposure. In exchange, the Federal Government promises to indemnify the launch operator for up to $1.5 billion in "excess claims" above the MPL, after which the launch operator's financial responsibility continues.

Why did the Congress create this regime?

After the *Challenger* accident in 1986, national policy decided to transfer the launch of all commercial and most military and civilian satellites from the Space Shuttle to the nascent commercial ELV industry. However, industry wasn't willing to "bet the company" by assuming total liability for the improbable (less than one in ten million) but huge losses that could result from a catastrophic launch accident. So far the regime has worked well, and never cost the government a penny.

Should the government indemnify space tourist rides, though?

First of all, the government is not protecting a sub-orbital RLV company from a lawsuit by its customer in the event of a tragic accident. Those "second party" liability issues will be handled by contractual cross-waivers and insurance.

Second, and more importantly, the government currently indemnifies U.S. entertainment companies that launch direct broadcast satellites on Ukrainian rockets by the Boeing-led Sea Launch consortium. Is fostering private investment in domestic reusable launch vehicles any less in the national interest than "subsidizing" people who watch the Playboy channel via satellite?

How should the government protect RLV "passengers"?

The very use of the word passenger, instead of the term used by the International Space Station partnership and in H.R. 3245—space flight participant—conveys an inappropriate notion of everyday transportation. Sub-orbital RLV flights are, we all hope, going to become frequent and affordable opportunities for people to experience space flight, but they are not—at least not initially—going to be a means of transportation between points A and B.

Furthermore, these are inherently new kinds of vehicles. They certainly aren't aircraft, but they also are very different from traditional ICBM-derived ELVs. Nobody has the knowledge base to write the level of safety regulations for RLVs that existed for aircraft even 50 years ago, because we haven't flown many (or arguably any) RLVs yet.

That said, no one expects sub-orbital RLVs to enjoy (or endure) the same two-plus decades of *laissez-faire* that existed for the early aviation industry. America is less risk-tolerant in 2003 than 1903, and commercial human space flight will not be granted an exception to cultural reality.

What the Federal Government can and should do is foster the gathering of knowledge that will lead to safer vehicles by allowing persons to voluntarily assume an informed risk in order to achieve their dream of experiencing space flight. That requires that the government take an affirmative role in requiring each RLV operator to propose vehicle-specific training and medical requirements during the license application process, as well as mandating the disclosure of the safety record of the RLV type to space flight participants before they can be carried for revenue.

This is a common-sense, evolutionary approach that will allow government and industry to both learn how to promote safety, instead of trying to arbitrarily impose safety ahead of time.

What, if anything, would you change about H.R. 3245?

Frankly, the legislation as written provides most if not all required statutory authority and jurisdictional clarity to help enable a growing sub-orbital RLV industry. Of course, there are other current or potential governmental barriers to success that could be addressed in legislation.

First and foremost is the issue of further empowering OCST to its job of regulating and promoting the U.S. commercial space transportation industry by moving it out of the FAA and creating it as a separate modal administration within the Department of Transportation. I cannot imagine a stronger signal of political support for this industry than for Congress to decide that industry merits its own distinct Commercial Space Transportation Administration, with a Presidentially-appointed and Senate-confirmed Administrator that reports directly to the Secretary of Transportation.

Not only would a CSTA be free of jurisdictional interference from OCST's more powerful siblings inside the FAA, but more importantly it would be free of the FAA's dominant bureaucratic and hyper-regulatory culture.

To some extent, Section 4 of H.R. 3245 invites the Secretary of Transportation to take executive action that would produce this very result. By directing the Secretary to propose an enabling regime which promotes as well as regulates the nascent commercial human space flight industry, the Congress is setting forth the appropriate "performance requirements" that could justify a "separate modal administration" design solution. Arguably the existing language is sufficient, and may be as far as the Congress is willing to go at this time.

Anything else?

My second suggestion would be to authorize and direct OCST to create a less burdensome licensing process for the experimental flight test of RLVs. Available only to non-revenue, developmental flights, this regime could be modeled on the FAA's minimalist regulation of experimental aircraft. Certainly OCST could be encouraged to waive or reduce those requirements which do not impact on public safety and which are within its control.

However, the largest single burden in the licensing process is not any requirement created by OCST itself, but rather the legally-imposed mandates of the National Environmental Policy Act (NEPA). Because issuing a launch, re-entry, or site operator license constitutes a "major federal action," an environmental assessment of the cumulative impact of the licensed space transportation activity must be conducted before the license can be issued.

It is this requirement that forces Elon Musk's company, SpaceX, to pay to count the sea lions near the Vandenberg Air Force Base launch site, as he testified to on July 24th. It is this requirement that could cost space ports hundreds of thousands of dollars before a single RLV flight can take place from their isolated location. It is this requirement that leads a few to wish they could launch RLVs under the "categorical exemption" (or "CATEX") provided to aviation under the NEPA.

There is no way Congress could or would absolve OCST (and the sub-orbital RLV industry) from its NEPA responsibilities. But Congress could, conceivably, take two affirmative steps. First, legislation could direct OCST to use all available resources to pursue a CATEX for RLV operations with other federal agencies. Of course, there are no guarantees here, and a strong legislative solution would trigger a referral to committees more concerned about protecting the EPA's (and their) jurisdiction than commercial space transportation.

The other option would be to take the same approach but seek a waiver of NEPA or other lessening of the environmental assessment burden only for research and development (i.e., experimental flight testing) of RLVs. Because these test flights could be more constrained (in location and quantity), presumably the environmental impact would be much more limited in amount and duration.

Of course, the issue is not actual environmental impact (all licensed launches have had a Finding of No Significant Impact), but the NEPA's requirement of a lengthy and costly assessment for both the launch activity and the launch site, include all possible future licensed activities at the site. That burden should not be levied on non-revenue R&D activities.

Perhaps it would be possible for the Science Committee, given the Chairman's and Ranking Member's senior positions on two other committees of relevant jurisdiction, to explore possible solutions to this problem over the next few months. However, I would not recommend that this issue slow down passage of H.R. 3245 beyond early 2004.

Conclusion

On behalf of the emerging commercial sub-orbital RLV industry, let me once again state my appreciation for the time and attention given these issues by the Subcommittee. H.R. 3245 as introduced is an excellent start at crafting enabling bipartisan legislation that will help this industry create huge economic, scientific, and even national security benefits for the United States. Hopefully the Full Committee on Science can hold a perfecting mark-up very early next year, followed by House passage, conference, and enactment into law as soon as possible.

JAMES MUNCY

Right Concern, Wrong Prescription

My old friend Gary Hudson is right to worry about the regulatory barriers facing the suborbital reusable launch vehicle industry, "Right FAA Role is Crucial" [Oct. 20, page 13], but his prescription that entrepreneurs simply fly under experimental aircraft certificates ignores the fact that building a company requires flying for revenue.

This year we are all celebrating the historic achievement 100 years ago of two inventors-turned-businessmen. Of course, today's rocket plane companies and their investors face a much tougher political, regulatory and legal climate than did the Wright Brothers, who only had gravity and North Carolina crosswinds to contend with.

In 100 years aviation has been transformed from the pioneering realization of an ancient human dream to a commodity transportation service. Along with this change has come layer upon layer of regulation, organically built up over several decades to reflect the experiences of a long-mature "common carrier" industry. In fact, in 1996 the Congress took away the Federal Aviation Administration's role of promoting the U.S. aviation industry so the agency could focus on maintaining safety as more and more people flew more and more places more and more often.

Fast forward to 80 years after Kitty Hawk when U.S. President Ronald Reagan and Congress agreed to create a new, one-stop shop in the Department of Transportation that would both promote and regulate the nascent commercial rocket industry.

The new Office of Commercial Space Transportation was placed in the Office of the Secretary — not the Federal Aviation Administration. The new office then developed a regime for overseeing commercial launch activities that would be separate from aviation regulation, albeit one aimed at large, potentially-destructive expendable rockets instead of small, reusable (and therefore more reliable) space planes.

Fast forward another decade to 1996. Even as Congress was refocusing the Federal Aviation Administration on regulation and operations, U.S. Vice President Albert Gore's "reinventing government" initiative mandated that cabinet secretaries downsize their offices, and so the Office of Commercial Space Transportation (OCST) was moved from the Office of the Secretary of Transportation down into the Federal Aviation Administration and renamed AST (for the office of the associate administrator for space transportation). While commercial rockets are still only supposed to be regulated by OCST/AST, the political reality is that space transportation decisions will now be made under the influence of the Federal Aviation Administration's risk-averse bureaucratic culture.

There's no question that the prospective Wright Brothers of the 21st century spaceplane industry face a regulatory maze inside the Federal Aviation Administration. So it is no wonder that some would seek a regulatory detour by attempting to fly their reusable launch vehicles as experimental aircraft. But instead of shortening the journey towards a successful reusable launch vehicle industry, at best the experimental aircraft path stops abruptly at a dead end, while at worst it could lead the whole industry right off the economic cliff.

It is true that an experimental type certificate is easier to get than a launch license, but at what point does a winged rocket become too powerful (and therefore potentially dangerous to uninvolved third parties) to fly as cavalierly as a one-seat airplane?

Eventually suborbital reusable launch vehicles will grow into orbit-capable reusable launch vehicles and they won't be able to dodge launch regulations (and international space legal regimes) by pretending to be just fast and high-flying aircraft. Besides, some funded vehicles simply are not aircraft. Should those approaches be penalized because they can't pretend they are not rockets? The real danger of the experimental aircraft detour is in the word aircraft: once you turn commercial, you'll face the same 75-year accumulation of aviation rules as do Boeing and United Airlines, which means you'll need the same deep pockets to win Federal Aviation Administration approval. Somehow I don't think even the wealthiest space plane backers want to pay a 100 percent or greater regulatory compliance tax on top of their initial investment.

Which means that the suborbital reusable launch vehicles that Gary Hudson and I both want to see built and cost-effectively flight-tested will never be funded in the first place, making the whole debate over launch licensing vs. aircraft certification moot. If the regulatory regime for space transportation is still too aligned to expendable launch vehicles or otherwise burdensome, then let's fix that. If an experimental launch vehicle regime needs to be created, then do that.

No one thinks AST's space transportation regulations are perfect, not even the people who wrote them. The rules will improve based on real world experience as companies like Armadillo Aerospace, Scaled Composites and XCOR blaze regulatory and (hopefully) commercial operations trails, just as aircraft regulations changed back in the 1920s and 1930s when industry and government learned together what did and did not work.

But if complying with AST's rules — intended only to protect uninvolved third parties — is too hard, imagine the challenge of meeting aviation regulations designed to protect Aunt Minnie when she travels from Detroit to Dallas. Suggesting that the space plane industry collectively leap out of AST's space transportation kettle into the Federal Aviation Administration's aviation fire is not a solution.

Instead, perhaps we should move the regulation of the emerging suborbital reusable launch vehicle industry as far away from aviation rulemaking as possible, and restore the former Office of Commercial Space Transportation's independence and strengthen its industry-enabling mandate.

James Muncy is an independent space policy consultant working with several companies in the suborbital reusable launch vehicle industry.

A "CLEAN SHEET" PERSPECTIVE ON PROMOTING AND REGULATING THE COMMERCIAL SPACE FLIGHT INDUSTRY

GARY C. HUDSON

OCTOBER 28, 2003

For the purposes of this white paper, I will generally assume that the current space flight promotional and regulatory structures of the United States Government (USG) do not exist. While naïve, a thought experiment that allows for the possibility of a "do-over" positively serves to focus our attention on first principles rather than waste time and effort parsing existing rules and regulations.

I make one initial assumption: that it is in the interest of the Congress and the American people to foster a healthy, growing space flight industry. Like the history of its predecessor, the air travel industry, the benefits seem obvious: the more frequently we fly and the more varieties of machines we fly, the lower the cost per flight. This is the way we will learn about making space flight safe and reliable and the result will be increased economic potential for the Nation. When we fly both frequently and safely, we begin to implement the dreams of a true commercial space frontier that generates wealth and helps provide for our future prosperity and security.

However, the desire to fulfill international treaty obligations and to protect public safety has led us to a cul-de-sac in the road to a hopeful future. We have stumbled in our ability to promote the space flight industry, imposing an unclear, overly bureaucratic regulatory environment that is stiffing innovation, progress and commerce. We need to rethink our approach from first principles; that is the purpose of this white paper.

The key question is how do we get from our present condition (no routine, affordable space flight) to a robust, innovative industry that creates new technologies and new commercial opportunities for our citizens? I believe the answer is to emulate the model that has given the United States—and with it the World—safe and cheap air travel. The process that has been used for the past one hundred years to bring us to the era of modern air travel can be profitably analyzed and adapted to provide the same boon for commercial space flight.

First I will discuss promotion of the industry, since the matter can be dealt with fairly expeditiously and because there is little debate about the desirability of some degree of industry promotion.

Industry Promotion. If we ask the "first principles" question, "why should the USG promote commercial space flight?" the simplest answer is to help U.S. companies employ, grow and generate revenue. If we assume that no entity currently exists to promote commercial space flight, how would the nascent commercial space flight industry best be served? Responsibility for promotion of commercial activities resides principally within the USG Department of Commerce. Such promotion is helpful only to the extent that it produces substantive results assisting U.S. companies in identifying opportunities and penetrating new markets. While there is tremendous potential to promote the growth of commercial space markets, including space tourism, the bulk of the current market for space launch services is in sales to the USG. The establishment of a DOC Office of Commercial Space (OCS) chartered to assist commercial space enterprises in doing business with other elements of the USG would provide the first step. We could consider this a "one-stop-shop" to assist companies in identifying USG business opportunities such as bidding on launches or spacecraft that serve USG needs.

To be clear, I am thinking of this office as an advocate for the companies rather than as a contracting office. For example, NASA is obligated by statute to purchase commercial space transportation services if offered by private entities rather than to develop its own systems. In the absence promotion and awareness, NASA routinely flouts this law. A Commerce Department Office of Commercial Space should be tasked by the Congress to insure that NASA and other USG agencies meet their statutory obligations. This will open opportunities for existing and emerging companies to provide commercial space transportation services as the Congress envisioned. Since emerging space flight companies do not have the resources to challenge taxpayer-financed legal departments at organizations such as NASA, the only fair way to exert real leverage on behalf of the emerging industry is to use government lawyers to deal with government lawyers. Hopefully just the threat of such a challenge would be enough to ensure it never reach the stage of legal action, and most matters would be addressed at the level of interagency policy board interactions.

DOC OCS would also administer any incentive programs that the Congress might establish in the future. For example, loan guarantees and insurance indemnifications have been proposed or passed previously. Without addressing the merits of either, I would assign the DOC OCS the responsibility for administering such programs. Likewise, should the Congress ever decide to establish prizes or other incentive programs of any kind, DOC OCS would be the point of interface and administration.

Industry Regulation. If we then approach the question of regulation from first principles we have to ask the question: "why regulate?" After all, Jefferson was famous for teaching "that government which is best, governs least." The air travel industry experienced it's "barn storming" era and operated for over 20 years before the creation of the Civil Aeronautics Administration in 1926.

It is believed by some that "licensing" by the USG of private actions in space (including space flight) is required to meet our obligations under the Outer Space Treaty. From first principles, one might question the desirability of continuing to adhere to an archaic and restrictive international agreement promulgated principally by diplomats of the former Soviet Union at the height of the Cold War. Their goal was to limit the ability of Western countries with free societies from maximally exploiting the benefits of private space flight. Asking for repeal of the Outer Space Treaty seems beyond the charter of this white paper, but we can fulfill the letter of the Treaty through a very mild regulatory regime. So, in the final analysis, the Outer Space Treaty alone is no bar to a sensible and adequate regulatory environment. I argue that a generic "approval" process, which does not rise to the level of a major or significant federal action, can provide the international fig leaf necessary for treaty compliance. Addition of an insurance requirement with the USG as a "named insured" can solve the liability issue created by the Treaty.

Past USG legislation refers to three specific elements that warrant establishment of regulatory oversight of space flight operators. First, and most obvious to virtually all observers is public safety. In addition, "national security" and "foreign policy interests" are also called out as justification. I will deal with public safety momentarily, but first it is helpful to address the other two issues, since they can be linked.

Much bad law is promulgated in the name of "national security." The best national security comes from a technologically vibrant and healthy growing economy. We can best defend ourselves when we are both rich enough to pay for the best defense, and when we can employ the most capable technology in our defense. Often time we damage our security and our international competitiveness in the name of "national security" and "foreign policy interests." The matter of export controls comes to mind. While this is not the forum for that particular debate, it needs to be recalled that the European Ariane program exists almost exclusively because, for "national security and foreign policy" reasons thirty years ago we elected to reject a French application to launch a Symphonie dual use communication satellite on an American booster. This decision led directly to the creation of the Ariane and its capture of half of the world launch market for two decades. Rejection did not make us any more secure than we would have been had we made a decision that would have prevented a united Europe from funding a highly competitive and subsidized commercial launcher.[1] And it hurt us badly from a commercial launch business viewpoint.

The need to act with regard to rockets and public safety is a far less controversial issue. One hundred years of air travel has resulted in a busy, crowded airspace that requires coordinated efforts to maintain safety. Few would argue that some form of regulatory oversight is reasonable. At the same time, few voices currently call for any but third-party protection. (First parties are the vehicle operators. Second parties are passengers or "space flight participants." Third parties are people with no relationship to the activity. Once the industry is mature, some degree of protection for second parties comparable to that in operation for civilian transport aircraft will be appropriate, but that time is decades in the future.)

Thinking from "first principles," let us bound the public safety problem by asking the question "why do we need the USG to regulate third party protection for space flights?" What is the risk to the public if all forms space flight were completely unregulated by the USG? We face many of our current problems because of our inability to understand risk, and our perception is that it is high. Lack of a technical understanding of how space vehicles operate and how much damage they can cause

[1] In a perfect world, I would not unduly restrict the overseas transfer of finished space launch components or systems (these being different than the technology or know-how to fabricate same) to countries who have shown they are not a near- or long-term threat to the U.S. (How to make this distinction? As historians note, no liberal democracy has ever gone to war against another. Let the Department of State certify acceptable countries and the matter is solved.)

seems at the root of this problem. The problem is further exacerbated by the way we visualize failure. Specifically, if one sees the explosion of a launcher, that explosion fills the screen of our television, simply because the cameraman is doing his job. This drama hides the truth. Insurance statistics, as evidenced by market rates of third party liability insurance, tell the real truth. No third party is injured in these failures! No third party was injured by the breakup of the Columbia, even though 200,000 pounds of debris fell over several states. So low was the risk that humans would be harmed, that only about 40 percent of the orbiter was even recovered; 60 percent burned up or fell and will never be found. And this is not merely the luck of the draw. Analysis of the impact to human life if the breakup had occurred one orbit later, placing it above Dallas-Fort Worth, has shown essentially identical results.

A number of constraints are present already on any space flight. For the vast majority of sub-orbital or orbital flights, space flight is an expensive proposition. The cheapest space flights are ones that do not go to orbit. In this case, a few efforts are currently underway to build small X-prize-class sub-orbital launchers. Yet the cheapest of these cost a few million to a few tens of millions of dollars, not a sum to be spent by irresponsible individuals or organizations. There are airspace restrictions imposed by the FARs. One can't simply build a rocket in the suburbs and launch from one's driveway. Another constraint is insurance. Suppliers often choose not sell propellant, avionics and other materials to builders who appear to lack common sense or minimal third party liability insurance. Even today, some X-prize contenders can't purchase the propellants they require because the manufacturers are afraid of liability, not from third parties, but from the flight crew or operator's employees who might sue if injured in ground or flight test. These and similar constraints on wild or irresponsible behavior are acting totally in the absence of any burdensome USG regulation.

Under FAR 101, provision existed for unmanned rocket flight approval by local FAA offices with only a fraction of current AST oversight requirements. In fact, we know this approach works, since many quite large amateur rockets, not to mention the U.S.'s first commercial rocket in 1981 and another in 1982, operated in a regulatory environment of exactly this nature. No injuries to any third parties resulted from this lightly regulated activity prior to the creation of Office of Commercial Space Transportation in 1984.

However, assuming that meeting our obligations under the Outer Space Treaty demands some further USG oversight, an option might be for the USG to establish minimum third party insurance requirements in order to obtain "approval" to operate space vehicles. Establishing this standard is straightforward—such calculation is a minor part of current licensing. The amounts set for "maximum probable loss" have so far been eminently reasonable, usually well below $100 million. This amount is readily available on the world market. I myself bought a comparable amount of third party liability insurance for less than $100,000 in 1981. I bought this insurance, not because of a USG mandate, but rather because our customer asked us to do so. (Note that I am not talking about "launch insurance" or that type of insurance that protects a spacecraft owner from launch failure and pays a claim if the launch vehicle fails to deliver the spacecraft to the desired orbit. There is a limited pool for such insurance, and premiums are very much higher than for third party liability insurance.) These premiums reflect the market knowledge that there has never been a third party claim of any magnitude in the history of Western space launch programs.

Once a maximum probable loss calculation was performed by the designated regulatory entity, I would recommend that it be reviewed and approved or at least concurred with by the aforementioned DOC OCS. This safeguard would prevent unreasonable regulators from subverting the process. I would also recommend that the entity setting the insurance standard be required to make the determination in writing within 30 days of a request for a determination, that the term of the determination be for a period of at least five years with a review at the one year mark to allow for the lowering of the requirement if the record of the vehicle or system so warrants, and that a appeals process including the DOC OCS be included in the law. Finally, a Congressionally set upper bound on the determination is needed, perhaps to be set at $500 million. However, no taxpayer-funded indemnity should be provided for amounts that exceed the Congressional upper limit. To do otherwise simply removes the incentives of third party plaintiff to settle any claims for reasonable amounts.

It is tempting to stop here and not explore more involved regulatory oversight of the type we currently see. But if we desire more oversight, at a minimum the scope and force of the regulation should be limited in keeping with the real, and not the

imagined risk, posed by commercial space vehicles. It should be comparable to regulations imposed on equivalent vehicles in a similar industry.

Every year, thousands of new experimental aircraft are licensed by the FAA via a one-page "experimental" type certification application, in addition to a one-hour or shorter inspection often times conducted by an FAA Designated Airworthiness Examiner who might not even by a government employee. Many of these aircraft crash each year. Usually pilots and passengers are killed and occasionally third parties as well. Experimental type certification applies equally to small home-builts, converted war-birds as big as a B–17, exotic aircraft built for research purposes and even jumbo jets prior to completing "standard" type certification that allow them to be sold and operated in passenger revenue service.

It is easy to show that the economic promise of the commercial space industry exceeds that of amateur built aircraft whose owners currently use the experimental type certification process. (I am not denigrating the social or economic value of these thousands of amateur-built aircraft, but simply making the point that the total dollars currently generated by commercial space launch already exceeds the market size of the home-builts by a substantial fraction. Once a growing space flight industry expands, that disparity will become even more obvious.) Since a third party casualty or fatality is just as hurt or dead if injured or killed by a Lancair-IV crash as they would be if they were the victim of an out of control SpaceShipOne, there is a gross disparity in the law if we treat space flight vehicles differently from experimental aircraft. Our failure is in our perception of an accident event, not in the results.

It is no challenge to say that space flight vehicles fail more often. Perhaps that is true; the casualty numbers suggest it is also irrelevant. Injured is injured, dead is dead. One might contend that space launch vehicles make bigger smoking holes in the ground, and thus have a higher potentiality for damage than a home-built. But this is also misleading. It is true that most (but by no means all) space flight vehicles carry flammable fuel (usually the same as commercial jets use) and oxidizers (such as the liquid oxygen that is stored in large tanks outside of every hospital in this country) and the unplanned mixing and combustion (or rarely detonation) of these propellants can be spectacular. Yet it should be remembered that most explosions of space flight systems are planned; they are the result of the system working, and the termination of flight in this manner prevents unmanned rockets from going where they are not wanted. It is quite rare that a rocket blows up on its own due to a systems failure; even so it is not unusual for such a problem to occur even with certificated passenger airliners, i.e., TWA 800 that suffered a fuel tank explosion, or several other similar accidents. The mere fact that rockets can produce larger explosions than some experimental aircraft does not change the fact that at any conceivable launch rate over the next few decades, with any imaginable failure rate, they can never exceed the currently acceptable casualty losses of the existing experimental aviation community.

The space launch industry labors under another burden not faced by experimental aircraft operators. When a developer wishes to design and build a new aircraft, no mater how big, fast or dangerous it may be, there is no requirement for any involvement of the National Environmental Protection Act. By creating a licensing regime specific to launch vehicles (as distinct from the approval process for aerospace vehicles controlled under the FARs), the USG has introduced the wild card of "Major Federal Action" now interpreted as requiring an environmental review, assessment or impact statement for each launch license. For the few dozen licenses issued to date, the results of these reviews have always been "FONSI" or Finding of No Significant Impact. The Congress can mandate that enough is enough and that no further review will be required for each license, or they can dispense with licensing altogether and simply designate launch systems as aerospace vehicles already exempt from NEPA under the FARs, not requiring such review. Millions of dollars continue to be wasted conducting these time-consuming reviews that have no measurable benefits. (The FAR already cover launch systems of all types, by definitions long-standing. An aircraft, according to the FAR, is a device that flies through the air under power. Power plant is irrelevant. Finally, the FARs also define what a rocket is. These definitions date from 1963.) So where do we go from here?

The establishment of OCST was promoted on the grounds that it would streamline a chaotic approval process. At the time, some alleged that as many as nineteen federal agencies had regulatory authority over launchers. While that number never proved to be anything but a sound bite, and flying in the face of approvals that had been granted to previous large commercial rockets a few years earlier, it is true that some USG entities did propose rather tortured interpretations of their regulatory authority. The most notorious was the Department of State, which proposed to regulate launches under the export control provisions of ITAR. It is necessary to make

certain that these spurious claims do not resurface, and it may be that legislation will be needed to further clarify the situation. The details are beyond my scope for the moment, but will deserve near-term attention when and if any of the ideas in this memo are implemented.

My recommendation is to dis-establish FAA/AST and to let the FAA local FSDOs once again control unmanned rocket flight under FAR 101 as was done prior to the creation of OCST in 1984. Insertion of a maximum probable loss calculation and third party insurance requirement into FAR 101 would be trivial. There would be no measurable impact on the safety of the public, but we would save $11 million per year now spent on AST or more than $100 million in the next decade alone.

But, what about piloted reusable space vehicles that carry passengers? They can also be handled quite simply. The chief objection that many have had to dis-establishing FAA/AST and giving all its functions to FAA/AVR is that experimental aircraft cannot be operated for hire and that full standard type certification is too expensive for new operators. Given that the Congress can direct the FAA to change *any* provision of the FARs, a simple solution would be to provide permission for any experimental aircraft to be operated for hire, provided the passenger is fully informed of the risks, the aircraft is not operated as a scheduled transportation service under part 121 of the FARs[2] and the maximum probable loss calculation for third partly liability insurance is applied. *This approach eliminates the claim that under AVR new operators would not be able to achieve the early revenues needed to attract investors and fund vehicle improvements.* The industry can be allowed to operate this way for some designated number of years—the barnstormers era—and then evolve an appropriate regulatory environment as experience is gained and the industry matures. Based on our experience with the development of the air travel industry, I suggest a period of twenty years until this provision sunsets.

Different provisions for piloted and unpiloted vehicles should be handled in the same way that FAA currently handles UAVs and piloted aircraft. Once deemed operational, vehicles will be flown—not on individual "launch licenses"—but instead after the filing of a flight plan in the same way an aircraft operator files for IFR operation. This is also how the FAA intends for UAVs to be integrated into the National Airspace System.

In this way the barnstorming phase of the commercial space industry can be nurtured, with demonstrably no new risk to the public, while providing an easy transition from experimental operations to early revenue service for "informed consent space flight participants." Ultimately the industry would be fully integrated into the successful air transport enterprise that has provided the benefits of air travel to all Americans.

In the next few decades we would be able to amend that phrase to "the benefits of air and space travel."

Implementation

Specific steps that should be taken to implement the philosophy espoused by this memo are:

1) Dis-establish the current AST organization. End the practice of launch licensing.
2) Confirm that unmanned rockets fall under the purview of the FAR 101 and that piloted rockets of all types fall under the FARs for experimental certification.
3) Confirm that to operate any unmanned rocket or piloted rocket, an operator need only obtain permission from the FAA per either FAR 101 for unmanned systems or applicable FARs for piloted vehicles.
4) Establish that experimental aerospace vehicles can be operated for hire with limitations to focus this provision on human space flight if deemed necessary.
5) Confirm that launch, space flight, operation to or on other celestial bodies and re-entry are not exports for the purposes of export control regulations. Further confirm that no other permits, licenses or approvals are required from the Federal Government to operate aerospace vehicles.

---

[2] If the FAA/AVR objects to this provision, they can be reminded that they are currently letting owners of experimental aircraft hire out experimental aircraft to flight instructors who then use them for pilot training. A sub-orbital or even orbital "space flight participant" can easily assume equivalent risk as a student pilot. A suitably controlling definition might also be developed that doesn't permit experimental aerospace craft to be flown for hire unless they are designed to operate over >50 Km altitude, to insure that only space vehicles benefit from this provision.

6) Establish an advocacy office with DOC to promote and represent the industry especially within the Federal Government.

PREPARED STATEMENT OF JEFF GREASON
PRESIDENT, XCOR AEROSPACE

1. Indemnification and licensing are not and should not be linked.

The Federal Government licenses many private activities without indemnifying those activities against some or all legal claims. Indemnification is not the quid pro quo for licensing; it is the quid pro quo for industry purchasing insurance that protects the government from the most probable third party claims.

.Quite unlike the early history of aviation, the U.S. government has chosen to accept a strict liability standard for space through the U.N. Space Liability Convention. As Mr. Hudson pointed out in his November 5th testimony, that was an unwise decision and not one for which industry should bear the burden. That is what has driven the U.S. government to force companies to purchase expensive insurance in amounts dictated by the U.S. government. Indemnification against excess claims beyond Maximum Probable Loss (MPL) is a way of mitigating the damage done to the industry by these choices. If the government wants to move towards a different third-party liability regime, withdrawing from the Liability Convention, establishing a limited liability regime similar to the Warsaw Convention, and removing the requirement to purchase MPL insurance, then there will be no justification for (and no need for) indemnification.

It has always been our belief that the launch operator is the sole party responsible for third party liability risk. Ms. Meredith made an excellent point during the November 5 hearing that this may require clarification. H.R. 3245 may benefit from additional language making clear that passengers and crew are not responsible for risks to third parties. In addition it also should be made clear that third party indemnification would not apply to passengers since they are not liable and are customers, rather than licensed launch operators.

2. Sub-orbital vehicles do not pose the same third party risks as current launch vehicles.

The Federal Government has spent billions of dollars on basic research to make expendable launch vehicles (ELVs) possible. In addition the government has spent billions of dollars making sub-orbital vehicles possible by funding the Mercury program, X–15 program, sounding rocket programs and even current efforts such as DARPA's RASCAL and FALCON programs. Sub-orbital RLV (reusable launch vehicle) companies now are poised to bring the taxpaying public some return on that investment.

Total third party risk from launch vehicle operations is a function of four factors: how reliable the vehicle is, how much destructive potential a vehicle has, where the vehicle flies, and how frequently the vehicle flies.

Despite the fact that ELVs are 'more mature,' they are not inherently more reliable than emerging sub-orbital RLVs concepts, and in fact can never be. By its very nature, each ELV is a different vehicle which can only be fully tested in actual use. Because of their high cost per vehicle, a launch provider may never conduct a single non-revenue test flight of a new vehicle, so there is some increased risk associated with early flights. It is this inherent complexity and risk that necessitates the so-called "advantage" of billions of dollars of federal subsidies and "standing armies" to provide oversight of ELV development and operations.

RLVs, on the other hand, can be affordably tested in an incremental way. Inexpensive empirical proof of reliability can supplant expensive analytical assumptions about reliability. Furthermore, over time an individual vehicle (as well as a specific design) can establish a clear and well-defined reliability track record. The need to attract customers, plus a regulatory mandate to publish the safety record, will promote greater testing and deliver greater reliability for the industry as a whole.

In a sub-orbital vehicle, the profit per flight is low enough that it takes roughly one thousand flights to make back the vehicle replacement cost. Therefore, anyone with hull loss probability worse than one per thousand flights would go bankrupt very quickly. Simple economics dictate that vehicle reliability will be at least ten times that of the ELV industry.

Because they are so much larger, carry more fuel, and require much more performance, ELVs can cause much greater damage from a worst-case accident than would a sub-orbital RLV. In fact, the huge potential for damage mandates the current systems approach to ELV safety: destroy the vehicle (and payload) before any observed failure can worsen and lead to catastrophic consequences. RLVs, on the other hand, can and will be designed to "fail safe."

Related to this is the issue of where ELVs and RLVs will fly. Many ELVs are launched from Cape Canaveral, and their launch operations are regularly constrained by that spaceport's closeness to significant population centers along the

East coast of Florida. Sub-orbital RLVs, on the other hand, will initially be able to fly in restricted airspace over sparsely populated terrain. They will only begin to overfly more populated areas after they have built up significantly greater reliability than is possible for ELVs.

Lastly, the notion that the frequency of sub-orbital RLV flights will somehow outweigh all the other factors and therefore create more total risk than for ELVs is patently false. First, sub-orbital RLV flight frequency will be lower during the initial flight test regime. But more importantly, it is the frequency of sub-orbital RLV flights that creates both higher and more precisely-definable reliability. Furthermore, each time a RLV flies it risks not only the mission value but also the capital asset value of the RLV. Since one flight will only earn back a fraction of a percent of the RLV's construction or replacement cost, simple economics will mandate reliability at least an order of magnitude greater than ELVs.

3. Increased sub-orbital flights will strengthen the 3rd party liability insurance industry for space transportation, not threaten it.

With fewer than 20 launches per year the current space insurance industry has economic factors that are inherently unique. Most insured industries have many times more insurable events. For example, millions of homeowners have fire insurance. Therefore the risk is spread out over many policies. Anything that increases the number of insured events in the space transportation industry will lower, not increase, the risk to the insurers. The more flights, the greater the usefulness of actuarial methods for assessing risk. This will make it easier for the insurance industry to set rates appropriate to the actual demonstrated level of risk.

Sub-orbital RLVs, whether passenger-carrying or not, are already held to extensive regulations to ensure their third-party liability risk is no greater than that of ELVs. No changes from the current AST approach is needed for this, and the risk of insurance claims is no higher for incrementally testable sub-orbital RLVs than for ELVs. Indeed, many types of failures that have destroyed ELVs would only abort the mission for an RLV.

4. The Federal Government has a compelling public interest in fostering a sub-orbital RLV industry.

There is a perception that commercial human space flight and sub-orbital RLVs are a "single use" technology; that they will fly a few rich tourists and have no other application or benefits. That is incorrect.

In the beginning, only the rich owned automobiles. The nascent airline industry likewise only carried the rich, and the airmail. Opening up any new market is a boon first to the wealthy customers (including DOD and NASA), then to a greater audience. A new ability to fly reusable rocket vehicles will benefit the entire space transportation industry and the U.S. government's strategic goals in space. Since the U.S. government has its own space launch capabilities (Shuttle, Titan, and now EELV), the primary benefit the government receives from commercial ELV operations is support of the industrial base. The more commercial activity, the less the U.S. government has to pay to maintain these capabilities and infrastructure. Sub-orbital RLV efforts will create private support for the aerospace industrial base. This is in addition to the benefits of high technology job creation resulting from a vibrant RLV and commercial human space flight industry. Indeed, while the workforce of the existing aerospace industry is aging, it may be critical to the continued competitiveness of the United States in aerospace that we foster the creation of exciting new aerospace industries such as commercial human space flight that will once again attract the best engineers and technicians.

Second, there is a clear U.S. government requirement for sub-orbital RLV capabilities. In civilian space, microgravity and science payloads have flown on expendable sub-orbital rockets since the beginning of U.S. space efforts and that activity continues today. Budget constraints have cut back sounding rocket flights in recent years. Adding low cost, reusable commercial sub-orbital capability will restore this research tool. In military space, current DOD efforts such as the RASCAL and FALCON programs employ sub-orbital components, some reusable and some expendable, for satellite launch and for sub-orbital delivery of military packages or munitions. Commercial RLVs will develop the technology base for DOD systems of the future, at no cost to the taxpayer. Industry can only develop these capabilities if customers pay for them; and human space flight participants can provide that critical customer base. Initial flights will be expensive because vehicle development will have to be paid for, therefore the revenue will come from customers who can afford a high price.

Third, if commercial human space flight is allowed to proceed, it will soon enter the normal development cycle of ever-increasing safety and efficiency that we see

in all other areas of technology. Early aircraft, cars, computers, VCRs, and televisions were at first all very expensive. The research and development were funded by the initial customers who paid a high price for them. If nobody had paid that high initial price, these commodities would have never developed into their current ubiquitous cheapness and utility. The United States government has funded space technology development for more than 40 years, yet access even to brief space experiences remains a distant dream for U.S. citizens. Allowing industry to offer space flight to risk-tolerant adventurers means that soon ordinary citizens can realize their dreams in space. This will also open a new frontier for the United States and for all humanity.

5. The regulatory and promotional functions of AST are not in conflict.

It is true that AST has two distinct public policy goals: protecting public safety AND enabling a competitive U.S. commercial space transportation industry. These goals are not so much in conflict as they are complementary. Since frequent early failures would damage the industry, it is in the industry's interest to work towards greater reliability.

Furthermore, effective streamlined regulation is often the best way to enable an emerging industry, just as the early aviation industry approached the Federal Government seeking regulation during the 1920s. The primary "promotional" activity of AST is to develop regulations which protect public safety without killing the industry. Without a promotion responsibility AST would have absolutely no need to consider the burden to the industry while developing regulations. If safety is the sole concern, not allowing anyone to fly is a legitimate approach.

Commercial aviation went from 1926 to 1995 with the same agency carrying the promotion and regulation mission. Clearly this did not pose a major threat to public safety, and it did result in a successful and safe aviation industry.

6. While the government may take steps to promote safety, space flight participants must be responsible for their own risk and must decide how much risk is acceptable to them.

Sub-orbital trips are not a ride at Disneyland (fake adventures meant to mimic real-world adventures). Sub-orbital rides are similar to climbing mountains or scuba diving: real adventures with their own inherent risks the participant willingly takes, in order to have a once-in-a-lifetime experience.

However, we are not advocating a "hands off" policy. The Federal Government can and should take steps to set us on the road towards ever-increasing participant safety. Setting a specific level of safety now will result in either setting the requirement too low, removing incentives to push safety as hard as possible, or too high, crippling the industry. Indeed, different vehicle concepts will have different initial safety records that may not reflect their potential in well-developed systems.

Requiring vehicle operators fully to disclose safety records facilitates continuous safety improvement without falling into the trap of a single one-size-fits-all standard that will ultimately fail to ensure passenger safety. At the November 5 hearings, Mr. Duffy correctly pointed that most accidents on launch vehicles happen in the first three flights. Reusable Launch Vehicles will probably fly ten times that number before the first passenger-carrying flight. This is a great virtue of RLV's low reflight cost: a level of demonstrated reliability that the ELV industry simply cannot afford.

Barring additional massive government spending, the only way to get the sub-orbital industry off the ground is to allow companies to innovate and take risks. A single accident could wipe out a company, but not a robust industry with multiple launch operators. By making safety records public, customers will gravitate to the safest providers. It was not until 1934 that public disclosure of accident causes was required of aviation; space vehicles already have accidents investigated by NTSB and disclosed. H.R. 3245 in its current form, requiring public disclosure of a carrier's safety record, imposes on the space industry a safety measure resisted by air carriers for decades during the early history of aviation.

All three current RLV launch license applicants plan a substantial flight test program; Scaled Composites has already done many flights of their test program and plans many more, XCOR has done 15 flights of a test vehicle developed for the purpose of flight-testing technology and laid out plans for a more extensive test program for their sub-orbital vehicle in their license application to AST. The fear that space flight participants would somehow fly on an untested vehicle is unfounded, and forcing disclosure of safety records will drive less-safe vehicles from the market.

7. It is neither necessary nor desirable to address all possible future concerns in H.R. 3245 today.

Some critics of H.R. 3245 have raised additional issues for consideration or pointed out that H.R. 3245 does not address all problems which may arise in the future.

While we agree that H.R. 3245 does not address all possible future concerns, we see no reason for it to do so. The *Commercial Space Launch Act of 1984* has been amended before and it will be amended again. During the history of aircraft regulation, the legal structure governing regulation changed many times. It is inevitable that as the industry develops and lessons are learned, the regulation and the law governing the industry will change. It is enough for H.R. 3245 to address the immediate concerns raised by the emergence of commercial human space flight and suborbital RLVs; the future will undoubtedly develop differently than we expect. The important thing is to create a good initial framework on a timely basis, and we believe H.R. 3245 meets this test very well.

8. Commercial human space flight is far from mature; it is just about to begin.

While government efforts have carried humans into space since 1961, true commercial human space flight has yet to begin, and that early state of the industry must be kept in mind in considering H.R. 3245. Currently, astronauts aboard NASA vehicles face a risk one million times greater than the risk faced by passengers on commercial aircraft. Government space flight efforts rest on expendable or semi-expendable craft in which major elements are newly manufactured for each flight and, by their nature, cannot be tested in a realistic environment before use. It is the absence of such testing which makes quality control in ELVs such a demanding task requiring the resources of a large organization. Given that background, it is not surprising that in the 40 years of government human space flight there has been little if any significant improvement in safety.

Simple economic necessity will drive the operators of RLVs to a higher safety requirement than government space flight efforts. Unlike governments, private companies simply cannot afford a high rate of loss-of-vehicle accidents; if vehicles crash often and must be substantially repaired or replaced, the company will go broke. Previous space technology has never been driven to meet commercial requirements such as not throwing away expensive assets, and we have not yet seen even the beginning of progressive improvement in safety. Therefore, we truly are starting from scratch: we have the resource of the technologies developed over the last 40 years, but not the benefit of an operational track record in relevant systems. The last 40 years of expendable launch vehicle technology bear the same relationship to RLVs as vacuum tubes did to transistors; the basic circuit principles were similar, but the implications for system design were very different.