The Virginia Joint Commission

JCOTS

on Technology and Science

MID-ATLANTIC REGIONAL SPACEPORT: BACKGROUND INFORMATION ON THE SPACEFLIGHT INDUSTRY AND THE DEVELOPING PRIVATE SPACE LAUNCH MARKET

Report to the Aerospace Advisory Committee of the Joint Commission on Technology and Science

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5/17/07

Introduction to New Space

Historically the aerospace industry has been dominated by large government agencies and contractors. The two largest sources of funding for the industry traditionally have been contracts with the National Aeronautics and Space Agency (NASA) and the Department of Defense (DoD). In the past few years a paradigm shift has begun for this industry away from government funding. The result has been a proliferation of smaller, streamlined, and entrepreneurially-minded aerospace companies. These companies are collectively referred to as "New Space", a reference to the fundamental difference in their business models from the old regime. Many of these companies have been founded and funded by highly successful internet entrepreneurs. After years of research and development, a few of the New Space companies are beginning to produce marketable technologies and vehicles that need to be tested and demonstrated.

As outlined in the remainder of this paper, the Mid-Atlantic Regional Spaceport (MARS) on Wallops Island, Virginia is in a unique position to serve the burgeoning New Space market. Virginia is presented with the historic opportunity to become the focus for a new industry, an industry that some analysts are calling the next big high-tech boom.

Recent Federal Spaceflight Regulations

In 1984 Congress passed the Commercial Space Launch Act (CSLA) in a recognition that spaceflight would no longer be an exclusively federal effort. After years of confusion, amendments, and misguided regulation Congress passed the CSLA amendments of 1998, which most significantly designated the Federal Aviation Administration (FAA) as the lead agency and led the way for a simplification of permitting launch activities. However, still plagued by an overly burdening regulatory framework, the New Space industry lobbied and succeeded in getting Congress to pass the CSLA amendments of 2004.[1] The act states among its findings that "private industry has begun to develop commercial launch vehicles capable of carrying human beings into space and greater private investment in these efforts will stimulate the Nation's commercial space transportation industry as a whole."[2] The purpose of the act is to promote the commercial spaceflight industry by "simplifying and expediting the issuance and transfer of commercial licenses" by the government.[3] Additionally, the act specifically allows for the possibility of a state government acquiring existing US launch facilities.[4]

Historic High Cost of Space Launches

Due in part to the aerospace industry's reliance on the federal government for contracts and in part to the engineering complexity of rocket science, the cost of lifting objects to orbit has historically been prohibitively expensive. In 2000, the average cost to

[1] Public L. No. 108–492, 118 Stat. 3974 (codified at 49 U.S.C. 70101 et seq.).
[2] 49 U.S.C.A. § 70101(a)(11) (2007).
[3] 49 U.S.C.A. § 70101(b)(2)(A) (2007).
[4] 49 U.S.C.A. § 70101 (2007).

launch one pound of payload to orbit was calculated at $11,729.[5] The incredibly high cost of achieving orbit has limited growth in the aerospace industry by requiring a tremendous capital investment in order to operate in low earth orbit.

Despite the high costs involved in orbital launches, the private satellite market has flourished. Satellite radio companies, satellite television companies, satellite phone companies, and satellite mapping services all attest to the growing private interest and use of satellites. Until recently, orbital launches have been limited to operations by large multinational corporations and the federal government. It has been predicted that unless cost per pound can be brought down to $1,000 or less, wide utilization and growth in the industry will not occur.[6]

Rise of Low Cost Alternatives

Industry experts have speculated for years that if a low cost alternative for getting to orbit could be developed then an entire new industry that operates in low earth orbit would blossom. Today a number of new companies have achieved historic milestones towards this end.

The most significant suborbital effort by the private sector to date has been the historic flights of Spaceship One in October 2004.[7] SpaceshipOne was privately built by Scaled Composites in order to compete for the Ansari X prize. It was designed and built for a cost of $25 million and successfully completed three suborbital flights, two within a ten day period. SpaceshipOne is now on permanent display at the Smithsonian's Air and Space museum.[8] Based on the success of SpaceshipOne, Scaled Composites is developing SpaceshipTwo which will be used for space tourism.

On June 12, 2006 a private company, Bigelow Aerospace, launched a spacecraft called *Genesis 1*.[9] This spacecraft is a prototype for private space station modules. The launch and subsequent operation of the spacecraft have been widely applauded as a tremendous success. Bigelow Aerospace plans to launch a number of additional test spacecraft with the end goal of launching the first privately funded and built space station.[10] Bigelow Aerospace's founder Robert Bigelow has invested approximately $90 million in his company to date and has stated he will invest no more than $500 million total.[11] This seems like a huge amount until it is compared with the International Space Station, which to date has an estimated cost of more than $100 billion.

On March 21, 2007 the industry saw another tremendous breakthrough for low cost space access. Another privately owned space company, Space Exploration

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[5] Futron Corporation, *Space Transportation Costs: Trends in Price Per Pound to Orbit 1990-2000*, at 4 (Sept. 6, 2002), *available at* http://www.futron.com/pdf/resource_center/white_papers/FutronLaunchCostWP.pdf.

[6] *Id*. at 6.

[7] Jim Hu, *SpaceShipOne repeats its feat*, CNET NEWS.COM, (Oct. 4, 2004), *available at* http://news.com.com/SpaceShipOne+repeats+its+feat/2100-1008_3-5394995.html.

[8] Associated Press, *SpaceShipOne takes its place at the Smithsonian*, MSNBC.COM, (Oct. 5 2005), *available at* http://www.msnbc.msn.com/id/9601983.

[9] Leonard David, *Bigelow Orbital Module Launched into Space*, SPACE.COM, (July 12, 2006), *available at* http://www.space.com/missionlaunches/060712_genesis-1_launch.html.

[10] *See generally*, Bigelow Aerospace, www.bigelowaerospace.com/multiverse.

[11] Leonard David, *Bigelow Aerospace Sets a Business Trajectory*, SPACE.COM, (March 26, 2007), *available at* http://www.space.com/spacenews/070326_bigelow_businessmonday.html.

Technologies Corporation (SpaceX), launched its second rocket, *Falcon 1,* which achieved an altitude of approximately 200 miles.[12] While the rocket's mission was not 100% successful (it did not achieve orbit), the rocket still represents a very important breakthrough. SpaceX will be launching again later this year and hopes to achieve orbit. For comparison purposes, the *Falcon 1* cost $7 million to purchase whereas the next lowest cost American rocket cost $25 million.[13] SpaceX is planning a family of low-cost rockets based on the *Falcon 1,* with the long term goal of achieving a cost to orbit of less than $1,000 per pound.[14]

The significance of these launches cannot be overstated. The United States stands on the brink of a new era in human space operations. It should be noted that there are many other companies entering this new market other than the few highlighted here. A few examples of the other companies currently working to achieve low cost space access are: Armadillo Aerospace, Blue Origin, SpaceDev, Benson Space Company, Xcor, T-Space, Planet Space, Rocketplane Kistler, and many others.[15]

Growing Investment & Interest

The sharp growth in private investment in this new generation of aerospace companies represents the belief by investors that this market could be the "next big thing." SpaceX was privately founded in 2002 by Elon Musk, an entrepreneur who has amassed a fortune estimated to be more than a billion dollars through internet start-ups. He has stated that he will personally invest up to $100 million in SpaceX. To date SpaceX has a launch manifest of 11 flights over the next few years.[16] SpaceX recently won a $278 million contract from NASA to demonstrate a rocket capable of servicing the International Space Station. SpaceX has also won a $100 million contract from the Air Force.

Bigelow Aerospace, similar to SpaceX, was founded by a billionaire entrepreneur, Robert Bigelow. As previously mentioned, Robert Bigelow has stated the intention of investing up to $500 million of his own finances to get the company going. To date Bigelow Aerospace has not announced the winning of any significant contracts, but as mentioned above, it has successfully launched the first completely privately funded space craft with great success. Robert Bigelow has publicly stated that his space stations, once operational, will require 16 or more orbital launches a year. Robert Bigelow has also offered a $50 million prize to any company that can demonstrate the ability to service one of his space stations by 2010.

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[12] Alan Boyle, *SpaceX lifts off after chills and thrills*, MSNBC.COM, (March 21, 2007), *available at* http://www.msnbc.msn.com/id/17695361.
[13] Leslie Wayne, *A Bold Plan to go Where Men Have Gone Before*, NEW YORK TIMES, (Feb. 5, 2006), *available at* http://query.nytimes.com/gst/fullpage.html.?res=9E03E3DA163EF936A35751C0A9609C8B63&partner=rssnyt&emc=rss.
[14] *See generally*, Space Exploration Technologies Corporation, http://www.spacex.com/company.php.
[15] *See generally*, Armadillo Aerospace, http://www.doomrpg.com/n.x/Armadillo/Home; Blue Origin, http://public.blueorigin.com; SpaceDev, http://www.spacedev.com; Benson Space Company, http://www.bensonspace.com; Xcor, http://www.xcor.com; T-Space, http://www.transformspace.com; Planet Space, http://www.planetspace.org; Rocketplane Kistler, http://www.rocketplane.com.
[16] SpaceX Launch Manifest, http://www.spacex.com/launch_manifest.php.

Another billionaire, Richard Branson, has started a space tourism company called Virgin Galactic. The company will provide suborbital flights to paying passengers on SpaceShipTwo, the craft being developed by Scaled Composites. To date over 200 people have paid deposits to reserve a seat on SpaceShipTwo at $200,000 per ticket.[17]

In addition to private investment, the federal government recently developed a program designed to encourage private companies to develop the ability to deliver cargo to the International Space Station (ISS). The contract is broken into two stages, the first stage is an initial $500 million award to help private companies develop space vehicles capable of servicing the ISS. The second stage of the contract, which will be awarded in 2010, is the contract for servicing the ISS. The Commercial Orbital Transportation Services Program (COTS) under NASA has awarded the $500 million to two companies to demonstrate their ability to service the ISS: SpaceX and Rocketplane Kistler. Also in 2010 NASA is retiring the shuttle which will create a minimum four year gap in human spaceflight capability. If a COTS competitor can offer human spaceflight capability then NASA may utilize it during this period in order to service the ISS. This is not outside the realm of possibility since at least one competitor, SpaceX, is using their COTS award to develop a vehicle that could be used interchangeably for both cargo deliveries and human spaceflights. If NASA's next spacecraft, the Crew Exploration Vehicle (CEV) falls behind schedule then one of these private operators would be in a perfect position to assume human spaceflight operations for NASA, even if for a temporary period.

These investments demonstrate the growing belief that the aerospace market is on the verge of tremendous growth. The individuals behind many of these companies have made millions of dollars as successful businessmen. Although they all have a passion for spaceflight, they are also responsible businessmen looking to make profitable businesses in the suborbital and orbital launch markets.

Potential Market

The Futron Corporation performed a recent study for the New Mexico Economic Development Department.[18] The study examined the potential economic impact to New Mexico that would result from the successful operation of their private spaceport. In summary, Futron estimates that the spaceport has the potential to provide the basis for creating approximately $460 million in additional economic activity in New Mexico, with some 3,460 new jobs in 2015. These figures could increase to about $550 million in additional economic activity and 4,320 new jobs in 2020."[19] The estimates include projections for suborbital launch and orbital launch business as well as ancillary support services.

Futron's study is admittedly conservative and fails to take into account the effects that some of these cost saving developments may have on the market. For instance Bigelow Aerospace predicts that it will be purchasing upwards of 16 orbital launches a

[17] Paul Marks, *Virgin Galactic announces its first 100 space tourists*, NEWSCIENTIST.COM, (Dec. 13, 2005), *available at* http://www.newscientist.com/article.ns?id=dn8457.
[18] Futron Corporation, *New Mexico Commercial Spaceport Economic Impact Study*, (Dec. 30, 2005), *available at* http://www.futron.com/pdf/resource_center/reports/NewMexicoReport_lowres.pdf.
[19] *Id.* at 4-5.

year to service its space station. This would greatly increase the total number of orbital launches globally.[20]

Virgin Galactic has also shown the potential market for space operations. To date Virgin Galactic has received over 200 deposits on $200,000 tickets as well as over 13,000 inquiries into purchasing tickets.[21] Another company demonstrating the potential market that could develop for space tourism is Space Adventures. Space Adventures is the Virginia based firm responsible for sending space tourists to the ISS for a cost of $20-25 million per tourist, with more still interested.[22] It takes only common sense to see that if there is a market for space tourists at today's high cost of space access, then demand would only increase as the price goes down.

Demand for Launch Sites

As companies such as SpaceX and Virgin Galactic begin to produce suborbital and orbital launch vehicles, the demand for launch sites will continue to grow. The FAA has currently issued five operator licenses to spaceports. The licensed spaceports include California Spaceport at Vandenberg Air Force Base, Spaceport Florida at Cape Canaveral Air Force Station, the Virginia Spaceflight Center at Wallops Island, Mojave Airport in California, and Kodiak Launch Complex on Kodiak Island, Alaska.[23]

Vandenburg Air Force Base in California and Cape Canaveral in Florida have traditionally been the two primary launch sites. There is frustration within the industry with these sites because the government launches that occur at both sites take precedence over commercial flights. The result is that private launches are given very limited windows within which to operate and are often delayed for months if there is a problem with a government flight. One company, SpaceX, has built a launch facility in the Marshall Islands located in the middle of the Pacific Ocean at its own cost in an attempt to fill the gap for their own launch activities. The need exists in the private spaceflight market for a business friendly spaceport. Located at the center of the East Coast corridor, Wallops Island is in a unique position to attract the launch business of these companies. This opportunity could potentially put Virginia in position to become the leading state in the emerging private space launch industry.

Emerging Spaceport Competition

In addition to the currently licensed spaceports, a number of efforts are being made across the country to open new spaceports that will cater to the private market. The spaceport effort that has received the most press is Spaceport America in New Mexico.[24] Spaceport America has received strong financial backing from both the state legislature and local county government. The legislature approved $100 million in funding for the spaceport. The first installment of $33 million is being made available to the spaceport this year and the remaining $67 million will be made available when the spaceport

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[20] Braddock Gaskill & Chris Bergin, *Lockheed and Bigelow Human-Rated EELV deal*, NASASPACEFLIGHT.COM, (Sept. 21, 2006), *available at* http://www.nasaspaceflight.com/content/?cid=4823.
[21] Marks, *supra*, note 13.
[22] Space Adventures, http://www.spaceadventures.com/index.cfm.
[23] FAA - About the Office, http://www.faa.gov/about/office_org/headquarters_offices/ast/about.
[24] Spaceport America, http://www.spaceportamerica.com/home.html.

receives an FAA launch license, which is targeted to occur in 2008.[25] The local county recently devoted a portion of its sales tax to the spaceport through a voter referendum. The tax is expected to generate up to $6.5 million a year for up to 20 years.[26] Additionally, Virgin Galactic has agreed to place its headquarters at Spaceport America and to launch suborbital flights there.[27]

Another state attempting to open a spaceport is Oklahoma.[28] The Oklahoma Spaceport has just received an FAA launch license. The Oklahoma Space Industry Development Authority (OSIDA) was established in 1999 by an act of the Oklahoma legislature. Oklahoma has also passed an act that provides tax incentives for space related businesses. Currently Armadillo Aerospace is performing test flight operations at the spaceport and Rocketplane Kistler has committed to using the spaceport for its suborbital launch business.[29]

In addition to the very large and shuttle-dominated Cap Canaveral, Florida is attempting to actively attract private space launch businesses. Florida is currently the site of NASA's shuttle facilities. In 2006 the Florida legislature passed the Space Florida Act which merged three space groups into Space Florida. Space Florida is charged with the task of attracting and promoting space related businesses in Florida.[30] SpaceX recently committed to using a launch pad at Cape Canaveral to launch its Falcon 9 flights in the next few years. Space Florida was instrumental in helping SpaceX obtain permission from the United Sates Air Force to use their launch facilities.[31]

The major point to be gathered from the growing New Space movement is that launch activities, both suborbital and orbital, continue to increase. There are a limited number of federally licensed spaceports and companies are not only competing against each other for use of spaceports, but also must compete with federal launch activities.

Virginia's Capabilities & Advantages

Virginia has several advantages and capabilities that place it in an ideal position to capture the burgeoning suborbital and orbital launch market. First and foremost, Wallops Island has a number of characteristics that make it a good launch site. Wallops has an established history as a launch site, it has an FAA launch license, and Wallops provides a large number of launch trajectories, enabling diverse applications for a wide variety of payloads. Additionally, NASA has a presence on Wallops and has committed to opening the launch site for commercial research.

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[25] Press Release, *Funding Allows Spaceport to Move Forward*, (Mar. 17, 2007) available at http://www.spaceportamerica.com/press/article.php?id=1224&title=Funding+Allows+Spaceport+to+Move+Forward.

[26] Press Release, *Spaceport America Ready for Blast Off*, (April 5, 2007) available at http://www.spaceportamerica.com/press/article.php?id=1231&title=Spaceport+America+Ready+for+Blast+Off.

[27] Leonard David, *Virgin Galactic Spaceliner Steps Forward*, SPACE NEWS, (Feb. 26, 2007) available at http://www.space.com/spacenews/businessmonday_070226.html.

[28] Oklahoma Space Industry Development Authority, http://www.okspaceport.state.ok.us/index.html.

[29] OSIDA Spaceflight Activities, http://www.okspaceport.state.ok.us/spaceflightactivites.html.

[30] Space Florida, http://www.spaceflorida.gov/index.shtml.

[31] Press Release, *Space Florida welcomes SpaceX*, (April 26, 2007) available at http://www.spaceflorida.gov/core/file.php?loc=/Web%20Sites/Space%20FL%20Web%20Sites/spacefl.solodev.com/web%20files/Content/Aerospace%20News/SpaceXrelease.pdf.

HB 3184 - Space Liability and Immunity Act

Passed by the 2007 Session of the Virginia General Assembly, the Space Flight Liability and Immunity Act provides spaceflight entities immunity from civil suit arising from spaceflight activities. The act does not provide protection for a space launch provider where they have injured a participant by acting with either gross negligence or intent. The bill goes on to state the minimum language that must be placed in the warning to the participant in order to gain protection under the act.[32] Virginia is the first state to enact legislation of this type. Initial reviews of the act by members of the spaceflight industry have been quite positive. The Act will expire on July 1, 2013.[33] The full text of the act as enacted can be found in Appendix B.

Retail Sales & Use Tax Act Exemptions

The Virginia Retail Sales and Use Tax Act provides several tax exemptions for space related businesses. The exemptions apply to space vehicles, personal property located on space vehicles, fuel for space vehicles, and machinery used for maintaining and developing space vehicles.[34] The act expires on July 1, 2011. The full text of the act can be found in Appendix B.

Wallops Island Flight Facility

The Wallops Flight Facility (WFF) was established as a launch facility in 1945, making it one of the oldest launch facilities in the world.[35] Since its beginning, Wallops has seen the launch of more than 14,000 rockets.[36] NASA has a facility on Wallops and has stated that one of the goals of that facility is "[t]o serve as a key facility for operational test, integration, and certification of NASA and commercial next-generation, low-cost orbital launch technologies."[37] Wallops offers a wide array of launch vehicle trajectory options. In general, it can accommodate launch azimuths between 90 and 160 degrees depending on impact ranges. For most orbital vehicles, this translates into orbital inclinations between 38 and approximately 60 degrees. Trajectory options outside of these launch azimuths, including polar and sun-synchronous orbits, can be achieved by in-flight azimuth maneuvers.[38] Wallops Island is currently able to support small launches, but would require extensive infrastructure improvements in order to handle medium or heavy lift launches.

Virginia Commercial Spaceflight Authority

[32] Va. Code § 8.01-277.8 *et seq*.
[33] Va. Code § 8.01-277.10.
[34] Va. Code § 58.1-609.3(13).
[35] http://www.nasa.gov/centers/wallops/about/history.html
[36] *Id*.
[37] http://www.nasa.gov/centers/wallops/about/index.html
[38] http://www.nasa.gov/centers/wallops/about/capabilities.html

The Virginia Commercial Spaceflight Authority (VCSFA) was created in 1995 by the Virginia Commercial Space Flight Authority Act.[39] The Authority was created with two purposes in mind, first to "disseminate knowledge pertaining to scientific and technological research" and second to "promote industrial and economic development."[40] In order to meet these objectives the Authority has been granted a number of powers, and is exempted from the Public Procurement Act and Personnel Act.[41] The Authority was also given the power to issue bonds. The Authority is governed by a board of directors comprised of appointed positions and permanent positions. The Virginia Commercial Space Flight Authority has successfully facilitated two private launches from Wallops Island, paving the way for future commercial flights. The VCSFA, in partnership with DynSpace, recently established the Mid-Atlantic Regional Spaceport, the entity formally responsible for private commercial development at Wallops Island.

Potential Obstacles & Barriers

There are a number of issues facing the Mid-Atlantic Regional Spaceport, which include land use planning, funding, federal/state relations, and infrastructure capabilities. The charge of the JCOTS Aerospace Advisory Committee will be to identify obstacles and barriers to development of the spaceport, specifically those that may require legislative action, and present a list of recommendations to resolve those issues. Additionally, the advisory committee will consider measures the General Assembly may take to speed the development and encourage utilization of the spaceport.

[39] Va. Code § 2.2-2201 *et seq*.
[40] Va. Code § 2.2-2202.
[41] Va. Code § 2.2-2215.

Appendix A: Va. Code § 8.01-227.8 -277.10

Space Flight Liability and Immunity Act

§ 8.01-227.8. Definitions.

For purposes of this section:

"Participant" means any space flight participant as that term is defined in 49 U.S.C. § 70102.

"Participant Injury" means any bodily injury, including death; emotional injury; or property damage sustained by the participant.

"Space flight activities" means launch services or reentry services as those terms are defined in 49 U.S.C. § 70102.

"Space flight entity" means any public or private entity holding, either directly or through a corporate subsidiary or parent, a license, permit, or other authorization issued by the United States Federal Aviation Administration pursuant to the Federal Space Launch Amendments Act (49 U.S.C. §70101 et seq.), including, but not limited to, a safety approval and a payload determination. "Space flight entity" shall also include any manufacturer or supplier of components, services, or vehicles that have been reviewed by the United States Federal Aviation Administration as part of issuing such a license, permit, or authorization

§ 8.01-227.9. Civil immunity for space flight entities.

A. Except as provided in subsection B, a space flight entity is not liable for a participant injury resulting from the risks of space flight activities, provided that the participant has been informed of the risks of space flight activities as required by federal law pursuant to federal law and this article, and the participant has given his informed consent that he is voluntarily participating in space flight activities after having been informed of the risks of those activities as required by federal law and this article. Except as provided in subsection B, no (i) participant, (ii) participant's representative, including the heirs, administrators, executors, assignees, next of kin, and estate of the participant, or (iii) any person who attempts to bring a claim on behalf of the participant for a participant injury, is authorized to maintain an action against or recover from a space flight entity for a participant injury that resulted from the risks of space flight activities.

B. Nothing in subsection A shall prevent or limit the liability of a space flight entity if the space flight entity does either of the following:

1. Commits an act or omission that constitutes gross negligence evidencing willful or wanton disregard for the safety of the participant, and that act or omission proximately causes a participant injury; or

2. Intentionally causes a participant injury.

C. Any limitation on legal liability afforded by this section to a space flight entity is in addition to any other limitations of legal liability otherwise provided by law.

§ 8.01-227.10. Warning required.

A. Every space flight entity providing space flight activities to a participant shall have each participant sign the warning statement specified in subsection B.

B. The warning statement described in subsection A shall contain, at a minimum and in addition to any language required by federal law, the following statement:

"WARNING AND ACKNOWLEDGEMENT: I understand and acknowledge that, under Virginia law, there is no civil liability for bodily injury, including death, emotional injury, or property damage sustained by a participant in space flight activities provided by a space flight entity if such injury or damage results from the risks of the space flight activity. I have given my informed consent to participate in space flight activities after receiving a description of the risks of space flight activities as required by federal law pursuant to 49 U.S.C. § 70105 and 14 C.F.R. § 460.45. The consent that I have given acknowledges that the risks of space flight activities include, but are not limited to, risks of bodily injury, including death, emotional injury, and property damage. I understand and acknowledge that I am participating in space flight activities at my own risk. I have been given the opportunity to consult with an attorney before signing this statement."

C. Failure to comply with the requirements concerning the warning statement provided in this section shall prevent a space flight entity from invoking the privileges of immunity provided by this article.

2. That the provisions of this act shall expire on July 1, 2013.

Appendix B: Va. Code § 58.1-609.3(13)

Retail Sales and Use Tax Act

The tax imposed by this chapter or pursuant to the authority granted in §§ 58.1-605 and 58.1-606 shall not apply to the following:

13. Beginning July 1, 1997, and ending July 1, 2011,

(i) the sale, lease, use, storage, consumption, or distribution of an orbital or suborbital space facility, space propulsion system, space vehicle, satellite, or space station of any kind possessing spaceflight capability, including the components thereof, irrespective of whether such facility, system, vehicle, satellite, or station is returned to this Commonwealth for subsequent use, storage or consumption in any manner when used to conduct spaceport activities;

(ii) the sale, lease, use, storage, consumption or distribution of tangible personal property placed on or used aboard any orbital or suborbital space facility, space propulsion system, space vehicle, satellite or space station of any kind, irrespective of whether such tangible personal property is returned to this Commonwealth for subsequent use, storage or consumption in any manner when used to conduct spaceport activities;

(iii) fuels of such quality not adapted for use in ordinary vehicles, being produced for, sold and exclusively used for spaceflight when used to conduct spaceport activities;

(iv) the sale, lease, use, storage, consumption or distribution of machinery and equipment purchased, sold, leased, rented or used exclusively for spaceport activities and the sale of goods and services provided to operate and maintain launch facilities, launch equipment, payload processing facilities and payload processing equipment used to conduct spaceport activities.