Commercial Space Transportation Advisory Committee
COMSTAC
October 7, 2010
Meeting Minutes

COMSTAC Chairman Will Trafton convened the Commercial Space Transportation Advisory Committee (COMSTAC) meeting at 8:43 a.m. The meeting was held at the National Housing Center Auditorium, 1201 15th Street, N.W., Washington, D.C.

Mr. Trafton praised the venue for the meeting and thanked those involved in organizing the two days of meetings.

He introduced those sitting at the head table – Dr. George C. Nield, FAA Associate Administrator for Commercial Space Transportation and James Van Laak, FAA Deputy Associate Administrator for Commercial Space Transportation, from the Office of Commercial Space Transportation (AST). He also introduced COMSTAC Deputy Chair Chris Kunstadter, senior vice president, XL Insurance. He then asked each member to introduce themselves.

Mr. Trafton stated his pleasure with COMSTAC events over the past six months. He noted that the bylaws have been approved and hoped they will provide incentive to members to be more active in participating on the Committee. He noted he had signed letters to support CCDEV and FAA licensing of commercial spaceflight providers and sent them on to Dr. Nield. Mr. Trafton observed that the working groups were tasked to develop their five top issues and that they have had some success with this task. Mr. Trafton stressed that the time is now to impact what happens in the commercial space arena. Laws will be passed and regulations put in place. COMSTAC can either participate or sit on the sidelines.

Mr. Trafton reviewed the working group activities from October 6, and noted that some are planning teleconferences during the next six months.

Mr. Trafton introduced Dr. Nield.

Remarks by Dr. Nield

Dr. Nield began his remarks with several announcements. He noted there was good news and bad news. The bad news was that COMSTAC member, Mike Kelly, had resigned from COMSTAC. The good news was that Mr. Kelly has joined the staff of AST as the new chief engineer. The previous chief engineer, Jim Duffy, has taken on the responsibilities of director of strategic planning.

Another personnel change within AST came with Jim Stasny's retirement during the summer. Mr. Stasny had handled external relations for the office. Dr. Nield then welcomed Jane Goodman as the new director of external relations and asked COMSTAC members to introduce themselves to her.

Dr. Nield noted the fast-moving, high-tech industry of commercial space. He cautioned that having a good idea and sticking with it isn't always enough to ensure success. He used the example of Blockbuster Video revolutionizing the way we see movies. Blockbuster filed for bankruptcy on September 23 of this year. The technology changed again, but Blockbuster didn't. Dr. Nield noted that regardless of the business we are in, we have to be responsive and flexible to keep pace with the times. Otherwise, we risk being left behind. Aerospace companies in the years ahead will need to continually assess their business cases.

Dr. Nield noted that COMSTAC is at the center of the nation's future direction in space. He reviewed events within the Office of Commercial Space Transportation:

- AST issued a launch license to SpaceX for the new Falcon 9 booster leading to a successful first flight on June 4.
- Later in June, the White House released a new national space policy. AST had a hand in developing that policy.
- AST has led an interagency effort to identify options for providing space traffic management services. The FAA is working with NASA, the DoD, the FCC and other agencies to discover how to accomplish that.
- In August, the FAA announced the New Center of Excellence for Commercial Space Transportation. The FAA will be investing $1,000,000 a year over the next ten years in matching funds for the Center. New Mexico State University was chosen as the administrative center. Other members of the team include Stanford University, University of Colorado, University of Texas Medical Branch, New Mexico Institute of Mining and Technology, Florida Institute of Technology, and the Florida Center for Advanced Aeropropulsion.
- Secretary of Transportation Ray LaHood, recommended creating an FAA Commercial Spaceflight Technical Center at Kennedy Space Center in Florida. The FAA could employ as many as 200 people at this center. AST is prepared to hire them and put them to work immediately doing research, developing standards, and overseeing regulations - all things that can help enhance the safety of commercial space transportation operations in the future. The FAA is awaiting Congressional approval of this Center.
- Last week, the FAA announced the first ever spaceport grants. These will fund projects to develop and expand commercial space transportation infrastructure. Grants were awarded for four separate projects in Alaska, California, Florida and New Mexico. Spaceport America will be getting funds for an automated weather observing system. The Alaska Aerospace Corporation will be building a rocket motor storage facility. Mojave Spaceport will be getting a new emergency response vehicle. Cecil Field in Florida will be developing a spaceport master plan. Although the amounts given out this year were relatively modest, the FAA is hopeful that the program can be expanded in future years.
- In July, AST issued a launch site operator license to Space Florida. The following month AST issued a license renewal to Orbital Sciences Corporation for conducting Pegasus launches from Vandenberg.

- AST recently inaugurated a lessons-learned website that allows industry and the public to submit lessons learned pertaining to commercial space transportation activities and operations.
- In May, AST completed an aircraft vulnerability proof of concept test that it hopes will eventually allow it to remove some of the conservatism that has traditionally been part of the calculation of aircraft risk assessments during launches.
- AST also just completed flying an experiment on a NASA sounding rocket. This is the first time an FAA-sponsored payload has flown on a NASA launcher.

Dr. Nield expressed his desire for continued communication with COMSTAC. AST needs the feedback and advice that COMSTAC has to offer. He thanked COMSTAC for all of its input on commercial space transportation issues.

Dr. Nield then introduced Michael Huerta, FAA Deputy Administrator.

Remarks by Mr. Huerta

Mr. Huerta noted that the work COMSTAC members are doing is extremely important. Our country has always asserted a leadership role in space. We will do so again with commercial space. The President is promoting commercial space as the way to continue our space policy. Secretary LaHood is also committed to the National Space Policy.

He went on to state that we need to make it clear to the country at large that commercial space matters. We need to communicate the message about what the commercial contribution is to the space program.

Mr. Huerta observed that he had held positions in government as well as industry. He noted that the private sector needs to take over because it's more efficient and can be more innovative. Government has a role to play as well. We need to sharpen and define the roles so that the future of our space program is bright.

Mr. Huerta stated that our nation's space program has excited him since he was very young. He anticipates that COMSTAC discussions will be exciting and focused on moving forward. Commercial space is an industry on the verge of exciting developments and COMSTAC is the group that's going to make it happen.

He thanked COMSTAC members for their willingness to participate in COMSTAC and thanked them for being here.

Chairman Trafton thanked Mr. Huerta for his remarks.

Mr. Trafton then introduced the keynote speaker, Phil McAlister from NASA's Commercial Crew Development Program. He encouraged the audience to ask questions following Mr. McAlister's presentation.

Remarks by Mr. McAlister

Mr. McAlister began by noting the one specific thing he wanted to talk about was the Commercial Crew Development Round 2 that NASA announced on October 1, 2010. When the program definition started to take place, it was important to state where it was going. That end state is safe reliable, cost-effective access to space.

Mr. McAlister stated that if NASA is successful, this program will strengthen the International Space Station program. It will further allow NASA to focus beyond low earth orbit. Low earth orbit transportation will be turned over to the commercial sector.

The commercial crew initiative has two distinct phases: the development phase and the services phase. The development phase will facilitate the development of U.S. commercial crew transportation with the goal of achieving safe, reliable, cost-effective human space transportation. Once that capability matures, NASA plans to purchase that capability through a firm fixed price contract services phase.

NASA will do this through competition. It wants multiple providers. NASA also wants an end-to-end system. NASA will not be the integrator. It wants the commercial partners to be responsible for the whole system from ground ops all the way through on-orbit operations, berthing, docking with the space station, return, recovery of assets and potentially refurbishment.

Mr. McAlister stated that NASA will require industry to invest its own capital as part of any agreement. This program will not only enable transportation to the ISS, but also anybody else who wants to go to space. NASA does not expect to be the sole customer for its commercial partners. It believes that the commercial partners should get a return on their investment by attracting customers in addition to NASA.

Safety is an integral part of this strategy. Private companies will have to ensure their systems are safe. This will happen through an insight/oversight approach. NASA has a white paper on its exploration website that describes this approach. Mr. McAlister went on to state that the onus for safety is still on the government. NASA will probably apply a human spaceflight certification for the commercial vehicles.

So, there are two goals. First is to have crew, NASA personnel or U.S.-designated astronauts, transportation to and from the ISS. Second, is to enable and support non-NASA markets for human spaceflight to and from low earth orbit.

NASA plans to keep its goals at a very high level. Obviously, safety requirements will have to be met. Within that, there is flexibility as to how commercial partners meet requirements. Mr. McAlister noted that NASA is already working with the FAA on how missions will be regulated and certified to ensure they are safe.

Mr. McAlister provided a look at the insight/oversight approach. NASA uses the term insight to convey its ability to penetrate the vehicle design, understand its capabilities and performance parameters. The way to do that is to embed NASA civil servants into the commercial partners' facilities. Oversight is direction to the commercial partner. It consists of approval and verification of the requirements. It is trying to identify discrete oversight events; a design review, for example.

NASA's previous practices were appropriate for what it was trying to do. This program is different, though, and NASA will seek to implement a non-traditional way of doing business. There is a very unique set of circumstances that make this the right approach. NASA has a relatively well-understood technology, a mature industrial base, and the prospect of other customers for commercial transportation services.

NASA expects to provide a significant base market for services: approximately four astronauts per mission, two missions per year. That's a sustainable market with the ISS.

Mr. McAlister noted there are strong prospects for other customers. First, the spaceflight participant market exists today. He mentioned market studies verifying this, especially the Futron Market Study in 2002. He also drew attention to Bigelow Aerospace and its private inflatable module for research and potentially space tourism purposes. Mr. McAlister further noted that the Administration has extended the life of the ISS to 2020 or beyond. This all makes a compelling argument for commercial crew.

The COTS cargo model provides a picture of what the commercial crew program can be. For an investment of about $500 million, NASA is hopeful to get two new launch vehicles, two new spacecraft, and two end-to-end delivery systems that can deliver cargo to the ISS.

Mr. McAlister noted that there is a synopsis of the Commercial Crew Development Program Round 2 online. He concluded with the expectation that there will be multiple Space Act Agreements executed out of Kennedy Space Center.

Mr. McAlister asked for questions.

Mr. Dickman noted that the timeline Mr. McAlister presented contained PDRs and CDRs. This sounds like a streamlined, better-managed development program. It makes it sound like getting to low earth orbit is new for anyone but NASA. We have Falcon 9 and Atlas V and Delta IV. Where do they fit in a cycle where NASA is back at PDR? Why aren't we using the stuff we have?

Mr. McAlister stated that NASA would obviously rely on some systems that have already been built and flown. They will still have to go through the process of ensuring that safety requirements are met.

Mr. Dickman noted that we have spent billions and billions of dollars getting things to low earth orbit and we know how to do that. Why don't we use that knowledge?

Mr. McAlister stated that NASA published its Commercial Human Rating Plan in May 2010. This plan shows Type 1 standards and Type 2 standards. Type 1 are those standards that operators absolutely must meet. Type 2 standards need to be followed, but could be replaced by an industry equivalent standard. NASA still needs a confidence that these systems are safe.

Dr. Nield asked what the FAA can do to help NASA have this program be successful.

Mr. McAlister stated that the FAA should keep doing what it is doing. The partnership NASA has with the FAA has been strong with the COTS cargo program. NASA looks to expand that partnership through this commercial crew initiative. He noted other ways the FAA and NASA have cooperated. He stated that some may be anxious to know how this partnership is going to play out. NASA is still working on that. They want to make sure they handle issues correctly. He thanked Dr. Nield for his support.

Mr. Holder asked if NASA was looking to expand funding for CCDEV2 beyond the level for CCDEV1.

Mr. McAlister stated that an anticipated value would be part of the Announcement for Proposal. Therefore, he was unable to discuss the issue further. The amount would be subject to appropriations.

Mr. Holder noted that NASA is looking for end-to-end solutions from commercial suppliers. He asked what NASA is doing to encourage awardees to make sure they have the entire system in place. What requirements will there be when we start taking commercial crews and their cargo to the ISS for use with NASA-standard equipment?

Mr. McAlister stated that NASA, first of all, communicates the fact that commercial operators must have an end-to-end system. NASA tells the commercial providers that they must take responsibility for the entire mission. That includes all ground support. NASA will not be the system integrator. That must come from the commercial partners.

NASA will also not provide items as government furnished equipment (GFE). It may change this stance on a case-by-case basis. For example, a docking system may become GFE.

Items such as spacesuits are design considerations. NASA is not going to dictate design. A commercial provider must meet the safety requirements. That is the goal. How they do it is up to them.

For NASA assets, like a test stand, NASA is not going to pay the O&M costs to maintain those facilities. When the shuttle program ends and there's no new program to pick up O&M, those assets will be vulnerable. If a commercial provider needs the test stand, that commercial provider is going to have to pay to make sure that the test stand remains open and active until they need it. All NASA assets, infrastructure, capabilities and expertise are available for commercial partners on a reimbursable basis.

Mr. Culbertson asked if NASA proposed to provide assets to commercial providers on a cost plus basis, but give them a fixed price contract to provide services. Does NASA expect providers to develop all these capabilities and still have a lower cost than the Government?

Mr. McAlister responded that when a provider needs a NASA asset, there is a reimbursable Space Act Agreement. The cost of using that facility has to be negotiated with the center. Mr. Culbertson asked if the centers would then compete with each other. Mr. McAlister answered, hopefully not. Most of NASA's facilities are unique. If there are some redundant capabilities, he would caution the commercial providers to make sure they understand the cost they are offered.

Mr. Culbertson agreed that it is necessary to understand the costs implied here. He noted that Mr. McAlister mentioned that the insight will reduce the need for oversight. What wasn't mentioned was that having all this insight will eliminate the expensive reviews that are incurred by the typical NASA oversight. The continuous oversight or insight model is going to look the same particularly if NASA sends 40 people to his plant to spend a lot of time there. It's the reviews that are expensive.

Mr. McAlister responded he did not know how many people would be involved in a review. It would vary for the commercial partner. Those people will not have authority to make any change or recommend any kind of change to your system. They're there to understand the true nature of the system. They will take that knowledge and bring it back to the oversight team. NASA will still have reviews, but not like the big NASA reviews. They're only going to be to verify that the requirements are going to be met. NASA will have a very streamlined board structure that will be much more efficient that in the past. Whereas previous reviews looked at every widget, every piece of hardware, they won't be doing that now. The only

part of oversight that NASA will have is ensuring that the safety requirements are met. There will not be a lot of detailed hardware specification. Only to the extent that safety requirements are met. He stated that this will make a more efficient and cost effective process.

Mr. Bray introduced himself as a 14-year Kennedy Space Center alumnus. He commented that NASA needs to keep in mind the human element of its people. There was a major accident six years ago. Four years ago, NASA underwent a major restructure. He expressed his opinion that the working troops who have dedicated their lives to human spaceflight need to see the value of this system of commercial crew development. NASA needs to market the system to its own people.

Mr. Bray continued to ask what assurances do contractors have under this process that there will not be another reorganization from fixed cost to cost plus. What assurance is there that this won't happen in the event of an eventual accident?

Mr. McAlister responded that he wouldn't want to give any assurance that would not happen. He can't predict the future. There are no guarantees. However, the commercial partners have asked for these changes and they've convinced the policy makers this is the right approach. Now it's time to step up. He expressed his belief that the industry is ready to do that.

Mr. Iyengar of United Launch Alliance noted that airplane safety has a single document called 91710. The FAA has Part 417. But NASA has a number of documents. He looks forward to a process where there will be a single document that providers can use. This would be extremely helpful.

Mr. McAlister stated there would not be a single document, but a smaller set of documents. Mr. Iyengar suggested creating a single binder of those documents.

Mr. Iyengar proceeded to his second question. He noted that Mr. McAlister had mentioned flexibility about safety requirements. He stated this is the right approach where industry has worked with range safety. It would be helpful, though, if NASA could release a document laying out the safety requirements up front at the requirements review stage or at PDR at the latest.

Mr. McAlister responded that this will be one of the features of CCDEV Round 2. The agreements are expected to result in significant maturation of crew transportation systems with consideration given to NASA's draft human certification requirements and standards. This will allow a dialog with industry about how to accomplish this.

Ms. Lepore asked to what extent NASA has seen any private investors come by to ask about the market potential and their role. Mr. McAlister answered that he was not aware of any centers receiving that type of inquiry. He stated that the investment industry appears a little more savvy on this market than in the past. NASA, while not having seen these questions yet, is open to the dialog.

Mr. Szoka stated that he wanted to give NASA a round of applause for mentioning space settlement as a goal. He asked how NASA sees that goal driving the decision-making process. How does NASA keep the goal clearly in mind over time and not drifting away from it? Mr. McAlister stated that's why NASA put the goal up front in its objective statement. The goal is to enable not only the mission, but also LEO transportation for any

purpose. The goal will become a part of the framework and become part of the way NASA does business.

Ms. Patti Grace Smith asked a question regarding insight/oversight. How does NASA resist, as it fulfills its modified role, putting things in the safety category that drive up costs for the operators? Secondly, as this process unfolds, where does NASA see the role of FAA licensing? How does a commercial entity provide end-to-end services without embedding the FAA in the discussion?

Mr. McAlister stated that NASA will be applying real safety requirements. There are two ingredients: strong leadership and an iterative process with industry. If there is a safety requirement that costs $200 million and a provider says it can ensure the same level of safety with a space-qualified part used in other flight programs that costs $2 million, CCDEV Round 2 is going to allow this kind of iterative activity. NASA believes this is a good balance between cost effectiveness and safety.

Mr. McAlister went on to state that the FAA is involved now. NASA hasn't decided exactly when FAA licensing would kick in. NASA will work with FAA/AST. Ms. Smith stated that she was talking about pre-decisional. How will the FAA become involved before you make the decision? Mr. McAlister again stated that the FAA is involved and will become more involved.

Mr. McAlister thanked Mr. Trafton for the opportunity to speak.

Mr. Trafton thanked Mr. McAlister for his presentation. He then called for a 10-minute break.

Mr. Trafton introduced the next presentation from Mr. Kunstadter, of XL Insurance, who reported on the Risk Management Working Group.

COMSTAC Working Group Reports

Risk Management Working Group (RMWG)

Chris Kunstadter, senior vice president, XL Insurance, began by offering a response to Dr. Nield's question to Mr. McAlister. That question was: What can the FAA do for the CCDEV process? Mr. Kunstadter stated that there are a lot of things the Risk Management Working Group is willing to do on the CCDEV programs because the risk management issues are still very undefined. There are a lot of things the insurance and risk management world needs to address in terms of liability and indemnification. He stated to Dr. Nield that this Working Group will be looking very closely at these issues as the CCDEV program goes forward.

Mr. Kunstadter noted that the Risk Management Working Group was well attended, at least partly due to the working group meetings being scheduled serially. He thanked his co-chair, Janet Sadler, for opening the meeting and running it.

The two topics covered during the meeting were on-orbit servicing and orbital debris. Charles Miller of NASA spoke to the working group on some of the issues related to on-orbit servicing. Mr. Kunstadter noted that there is a stronger push towards on-orbit servicing than in previous years. Mr. Miller painted a more drastic scenario than some, but it was probably not out of the realm of possibility. He discussed what COMSTAC ought to be doing in terms of looking at managing and regulating on-orbit servicing. Mr.

Kunstadter noted that "regulating" is a bad word in some circles, but it needs to be addressed.

On-orbit servicing has a number of different aspects. It covers spacecraft inspection and repair, life extension, and debris mitigation. Mr. Miller argued that the main risks had to do with collision and creating a cascading effect on different parts of the space economy and ultimately the world economy. The Risk Management Working Group recognizes the importance of the issue and takes on the task of following on-orbit servicing carefully. Mr. Kunstadter expressed his appreciation for Mr. Miller's comments and willingness to discuss the issues in some detail.

The working group discussion then turned to orbital debris. A year ago, Elizabeth Gonzales of AST presented some questions that the FAA has on upper stages left in orbit and the risk of not de-orbiting those upper stages. These questions were presented at a joint meeting of the Risk Management Working Group and the Space Transportation Operations Working Group. The two groups agreed to look at the questions. Other commitments have interfered with a more dedicated examination of the issues. The working group recognizes the need to ramp up work on the issue. The two working groups are looking to the launch vehicle operators for information on the upper stages left in orbit for any length of time. Nick Johnson of NASA presented the working group with some interesting numbers on what has been left up there. The working group needs to take that data and check it against information gathered from launch operators. This should give a picture on the magnitude of the problem. The working group can then report back to the FAA. Mr. Kunstadter noted that the working group could then develop a task to approach industry, or perhaps a Center of Excellence, on how to address the problem.

Mr. Kunstadter asked if there were any questions.

Mr. Collins asked if there was any ability to work with other agencies internationally to ensure this is not another step in U.S. noncompetitiveness in the commercial market. Mr. Kunstadter acknowledged this was an excellent point. The working group could start with the UN office in Vienna or other international forums to examine the issue. He would welcome any input on the subject. Mr. Collins stated he would like to work with the working group on the subject. He noted that there is no doubt that deorbiting upper stages is the right thing to do. But if it further increases the cost of supplying launch services, customers will go to others who are not doing it and that will not have a positive effect on business. Mr. Kunstadter commented that Mr. Johnson identified some non-U.S. companies who were the bad actors in that field.

Ms. Lepore noted that the STOWG had focused on this topic in its meeting and she would be reporting further on that discussion. On the orbital debris issue, what the working groups need is an examination of the costs, including the economic costs, competitiveness and oversight. There needs to be a level playing field for all operators. In particular, how will the U.S. assume a leadership role to come up with better ways to incentivize good behavior to keep the parks clean?

Mr. Kunstadter noted that we all want to foster the commercial space world. He thanked Mr. Collins for his input and stated that the working group would work with him on the issue.

Mr. Culbertson asked if Mr. Kunstadter could elaborate a little more on the on-orbit servicing discussion, and secondly is this something the insurance industry, in particular, will support. Mr. Kunstadter responded that he was not able to be present for the first part of Mr. Miller's presentation. The gist of it was that there needed to be some oversight or regulation of on-orbit servicing. Otherwise there was a risk of having catastrophic cascading events. He asked Ms. Sadler to comment. Ms. Sadler echoed Mr. Kunstadter's view that the orbital servicing issues are some distance away. She stated that Mr. Miller did paint an extremely gloomy picture of the potential hazards. This can lead to the conclusion to deal with things as we do at the moment. That is, we move them safely out of the way and put a new one up there rather than introducing additional hazards through modifying the original design to make them refuelable or repairable. Mr. Miller's main concern was about the finite geostationary arc. The real question was whether or not it should be a regulated activity to promote safety of the environment. The working group will look at that, but there are already significant regulations in place. In an international field, one has to be careful of extending regulation into places where you don't want regulation or where there shouldn't be regulation.

Mr. Kunstadter addressed the second question that Mr. Culbertson raised. He noted that the insurance industry has been responsive on the on-orbit servicing issue and there is no reason to think it won't continue to be responsive. His company has insured some missions that involved some complex proximity operations. In the case of the Iridium-Cosmos collision, Iridium had third-party liability insurance. It's a matter of understanding the possible scenarios and what the probabilities associated with them are. It's an academic exercise to determine the probability of a collision of Object X and Object Y. The range of answers is so great that it's hard to come up with anything that the insurance industry can use.

There were no further questions. Mr. Trafton commented that he sat in on the Risk Management Working Group session. He had expected the launch providers to leap out of their seats, as Mr. Collins had. The impact on the launch industry could be huge if it was told to add another engine or change its payload capability. The last thing we want is for someone to put this burden on the U.S. providers and watch the rest of the world do business as usual. The Risk Management Working Group will surely take on this issue. It will need input from the launch industry.

Mr. Trafton then introduced Debra Lepore, of DFL Space LLC, and her report on the Space Transportation Working Group session.

Space Transportation Operations Working Group (STOWG)

Ms. Lepore noted that there was an excellent turnout for the working group meeting. She agreed that the schedule of individual meetings with no overlap was a benefit and made the meetings more productive.

She stated that the STOWG has held two telecons since the May COMSTAC meeting. This goes to making the STOWG more active. The working group has reached out to the full COMSTAC membership and other working group members as well. She encouraged those who are interested to make sure we have their e-mail addresses so they can participate in future teleconferences.

The main topics under discussion were the draft CONOPS for Global Space Vehicle Debris Threat Management that staff from AST presented to the working group the previous October. Then the working group brainstormed the top issues and what the framework for the STOWG might be. In addition, the working group addressed the issues of cost of compliance with orbital debris standards just discussed.

Ms. Lepore began by looking at the CONOPS draft report. This report examines the issues when launch operations are integrated into the national airspace. The CONOPS looks at changing the way airspace closings are handled during launch and reentry. Instead of closing the airspace over a broad area during a launch or reentry, action would be taken only if an anomaly occurred. The action would be propagated at exactly the time of the anomaly. The question is how to operate in this mode. What are the pros and cons of this level of flexibility, and what is the cost of the additional instrumentation and communication devices? The two telecons during the summer focused on understanding the CONOPS and the issues. One person in the working group brought up X-37. What happened when they entered the airspace? This was a special military mission. It probably had more leeway than the shuttle, for example. The working group looked at the balance between focusing on failure and destruction versus nominal operations. What will normal become? Ms. Lepore noted that Mr. VanLaak has pointed out that anomalies happen on a daily basis in the aviation world – a cracked windshield, for example – and the airlines and air traffic control deal with them as they arise.

Ms. Lepore detailed the suggestions the working group gave the FAA/AST authors of the CONOPS.

- Orbital and suborbital vehicles may require different CONOPS.
- Launch breakup and reentry breakup should probably be handled separately. Operators know where a launch breakup will come from. A reentry breakup has more uncertainty.
- Repeatability of operations.
- Frequency of operations. How will things change as commercial launches become more frequent?
- Special equipment. What will be required? What will the cost of increased flexibility be?

The overall action for this issue is to continue the dialog. The CONOPS is a work in progress. STOWG is a good mechanism to facilitate the dialog between FAA/AST and industry. Ms. Lepore encouraged other COMSTAC members and the public to read the report and become involved in the discussions.

Ms. Lepore went on to the second subject under discussion, that of orbital debris compliance. This is the subject that Mr. Kunstadter introduced. It was presented to both working groups last October with a talk by Nick Johnson from NASA. That discussion was on orbital debris standards and compliance. Now these are voluntary and there is no punishment for noncompliance. The FAA/AST asked five questions about the cost of compliance. What would be the cost is the standards were not voluntary, but became requirements? In a short survey of launch providers the responses were anecdotal. Much

of the discussion looked at what would compliance mean for the market and for competitiveness. The working group agreed that it needed to reach out to the launch providers. The STOWG will try to do this in cooperation with the Risk Management Working Group. Another question that came up was how to quantify the data needed without getting into proprietary information. Hypothetical situations could be done on an open basis, but costs for a specific vehicle would be harder to obtain. Ms. Lepore noted that one proposal was to look at tasking the new Center of Excellence. Could a university develop a cost model with certain analysis capability and develop a tool where standard data could be input and results could be examined without getting into proprietary issues?

Ms. Lepore then reported on the discussion of the STOWG's top issues. The issues developed at the May meeting continue to be relevant. The working group, however, wanted to be more definitive than just having a laundry list of issues. Mary Lynn Ditmar volunteered to develop a draft framework pulling in all the complex issues of space transportation operations. She presented this systems approach to the working group. The STOWG will continue its discussion on this subject and try to develop a proposal for the May meeting. This type of overall framework could be a topic of interest for the new Center of Excellence. Can we develop a framework of integrated operations for the market and how the industry intends to operate? This concept led to a discussion of NextGen. It was in May 2008 that the working group had a briefing on NextGen. Ms. Lepore noted that the NextGen implementation plan has a picture of a satellite on it. Certainly, this relates to commercial space. The challenge facing the whole industry is how to integrate with this.

Ms. Lepore noted that a lot of vehicles are preparing to fly. They are going to be in the airspace sooner rather than later. The STOWG is pleased to be part of the mechanism to establish really good dialog on the issues. She encouraged COMSTAC members and the public to participate in the STOWG telecons and meetings. She asked for any questions.

Mr. Szoka referred back to the issue of when removing debris is more expensive than not creating it. He expressed the opinion that this may not absolutely be true. At some point, extra debris mitigation may be more expensive than figuring out how to remove large pieces. He asked what role there is in this tradeoff. At the same time you're working the track of improving mitigation, how do you find a way of making remediation legally possible and incentivize it?

Ms. Lepore appreciated the question and it reminded her that there was a proposal to have a speaker next May on the concepts of orbital debris removal. Ms. Lepore used the example of the national parks. What people bring into the parks, they remove. However, what do you do with debris that other leave behind? We expect the parks to be clean, but we don't want to pay a lot to clean them up. Space is an international park. We would like to create good behavior. If we can get the international community to realize that we don't want to create more space junk. If we can stop creating it, we don't have to remove it. Then the question is, what's the market? Who pays for it? Whose responsibility is it? If it's someone else's junk, who cleans it up? Many experts have been looking at these issues and I think they would welcome the conversation.

Mr. Szoka followed up on his question. He stated that it is important to choose the right metaphors as we take the lead in this process. It's dangerous to say we don't ever want to

create debris. Instead, we need to recognize there will always be some debris. The question is how much can we tolerate and how good are we going to be cleaning it up. We need to be careful not to give the international community the idea that the United Nations might come in and start restricting what we do in space to the point where it becomes prohibitively expensive to operate.

Ms. Lepore stated that these were good points. She suggested there might be a sixth question to ask. That is, what is the price of zero tolerance? If that is not a realistic price, what is a reasonable one?

Mr. Collins stated that ULA, on its L41 mission, did deorbit the upper stage. They have done this previously and do that whenever they can have the performance. He asked if the Working Group discussed where the mission ends. If they deorbit a stage, where does the liability end or transfer to someone else? We need to reach out to the space vehicle providers, as well as the launch operators.

Ms. Lepore replied that the Working Group had not had those conversations. The original survey generated anecdotal responses. The next question would then be, if you deorbit a stage, are we now looking at the CONOPS on reentry debris? Mr. Collins asked where range safety gets involved. Do they get involved when we bring these things back and what regulations come with that? Ms. Lepore stated that is exactly why we need this conversation. It is more complex than meets the eye. This is the reason for the conversation. Mr. Collins responded that in the next conversation he would be there.

Ms. Lepore asked for other questions.

Mr. Precourt noted that about eight or ten years ago the space shuttle program added an emergency landing site in Marseille in southern France. Many of the questions raised about the shuttle moving through the airspace were the same as the ones being asked now in the CONOPS. The French were concerned about closing their airspace for three or four hours. The system that was put in place precluded that type of closing. Mr. Precourt suggested that some of the people who worked with the French are still at NASA. He offered to help make those contacts.

Ms. Lepore thanked Mr. Precourt, then asked for any other questions. There were none. She thanked everyone for their attention.

Mr. Trafton thanked Ms. Lepore for her presentation. He then adjourned the meeting for lunch at 11:22 a.m.

Mr. Trafton called the afternoon session to order at 12:36 p.m. He introduced the afternoon speaker, Damon Wells. Mr. Wells is assistant director for space and aeronautics in the Office of Science and Technology Policy in the Executive Office of the President.

Remarks by Mr. Wells

Mr. Wells expressed his pleasure to speak to COMSTAC. He noted that it had been an active year for space policy. The President released his plan for NASA early in the year, the National Space Policy came out in June, and Congress passed the authorization for NASA a week or two earlier.

Mr. Wells stated he would focus on the National Space Policy in his remarks. He first looked as a context for his comments. He often discusses why space is important. That's not necessary for this audience. But, he asked, what is the purpose of the space policy? He noted that every administration since the 1950s has had one. This reflects the dual use of the technologies: high profile and the implications for national leadership. The first function of a policy is to provide guidance from the President to departments and agencies for their activities in space. It also has another function – external communications internationally and to industry about what our priorities are, what we care about, how we are going to do business.

Mr. Wells noted that the last space policy was released in 2006, but a lot has happened in the intervening four years. There are new opportunities, new challenges, and new threats in the space sector. Clearly, he stated, there are opportunities for international cooperation, but there are also maturing commercial capabilities that create new opportunities. The National Space Policy reflects the President's priorities, and reflects the integral role that space plays in the broader U.S. economic and national security sphere. The policy builds on what came before. There is continuity in terms of core principles and goals. These include exploring space for peaceful purposes, no national claims of sovereignty over outer space, and rights of passage without interference. The new areas of emphasis reflect the areas of international cooperation. This includes more stability in space, preserving the space environment for the future, data sharing, and how to build confidence and encourage responsible behavior in space.

Mr. Wells noted the increased emphasis on U.S. Government use of commercial goods, products, and services. This idea is woven throughout the policy. The administration has added a definition of "commercial" to the policy to attempt to make its meaning clear. The policy reinforces the guidance to use commercial goods as much as possible. It also encourages agencies to explore nontraditional acquisition arrangements and looks at pursuing opportunities to transfer routine space operations to the commercial sector.

Mr. Wells posed the question, why the focus on commercial? The intent is to spur innovation, look for ways to increase competitiveness, and to create jobs. Finally, to explore ways to address national needs in a cost-effective way.

Mr. Wells noted that there is emphasis on leadership in science and technology. There is direction for agencies to conduct basic and applied research that looks to increase capabilities and reduce cost. It also encourages an innovative and entrepreneurial commercial space sector. Then, it helps to retain space professionals. With the goal to achieve mission success comes the focus on space professionals.

Another element is to promote and expand partnerships with targeted investments. How best to do this? In the acquisition process, there is the need to better estimate cost and forecast typical risks in a more realistic manner. There is also the need to improve management of requirements. Increased testing will help buy down risk.

Mr. Wells noted that NASA's new approach is an integral element of the other themes in the policy about technology research and development, cooperation, and more use of commercial services. He noted the recently enacted 2010 NASA Authorization Act that supports many of the space policy priorities. Mr. Wells drew attention to the language

supporting commercial crew transportation. He noted there is a lot of work still to be done, but emphasized the promise that the government is on a stable path in space policy.

Mr. Wells closed his remarks and asked for questions.

Dr. Nield asked Mr. Wells to talk about the next steps in the policy arena. Mr. Wells noted that the first step is to implement the policy. There are several studies, tasks, and plans laid out by the policy for the agencies to work on. The first phase is to develop and execute plans in areas that did not already have a plan. In time, there will be policies in areas that have not yet been reviewed – space transportation, commercial remote sensing, and so on.

Ms. Lepore noted that one part of implementation is socializing and encouraging behavior within the U.S. Government and industry. She asked Mr. Wells to talk about that same process internationally. She noted that the U.S. is not always the best or most reliable partner, and export control has pushed more work and encouraged other countries to invest. How do we convince the world that this is something very serious and that we want to encourage partnerships?

Mr. Wells stated that we will have to start the conversations with potential partners to look at specific activities we might consider, activities that would have a mutual benefit. Many of these conversations need to be conducted internally before they are ready to be extended externally. It's an ongoing process.

Mr. Szoka stated that he sees a lot in the policy that he likes. He praised what the administration has done. However, the one thing he sees lacking from the space policy is a clear vision about why we are doing this. There is a great list of benefits, but two concepts are missing. The first is a focus on the ultimate purpose of everything we are doing, that is, a permanent settlement of humanity in space. The second is ultimately bringing the resources of space into our economic sphere. He asked what Mr. Wells could say about the purpose beyond cooperation and excitement and the listed benefits. It seems like the administration is missing out on a piece of the story that will tie it all together – that is the path to settlement of humans in space.

Mr. Wells responded that there are widely divergent opinions on the ultimate purpose for space activity. The administration's focus was not so much on the longer term, but on the near-term challenges of addressing cost growth, of getting on a more stable path, and of identifying achievable milestones. He thanked Mr. Szoka for his comments.

Mr. Holder referred to Mr. Wells's mention of the challenge of creating and maintaining a pool of space-capable technical personnel and that we must educate a new group. This is a problem that permeates the space industry, and in general, the science and technical industries across the nation. He sees a need for an overarching approach not just for STEM, but those technologies that benefit space technology. He asked is there anything that starts to create an integration across the different technology sectors for improving the source material for our technology professional. Mr. Holder noted there are efforts within different branches of the U.S. Government, but he doesn't see an overall vision of where we want to be as a nation and many technologies have more than one application. Mr. Wells noted that this is a good thought to mull over. There's been an attempt to coordinate and advance the STEM initiatives. There may be a need for something broader

outside of STEM. He did not have a specific response. Mr. Holder suggested that students need something beyond "math is good" and "engineering is good". They need something that catches their particular interest and makes the math and engineering personal. Mr. Wells agreed that students need something more grounded, tied to something they might actually do.

Mr. Gold asked if Mr. Wells thought that China might become a participant in the ISS. Would that be a good thing? Does he see this happening in the near future? Mr. Wells indicated this is a complex issue here and in China. He did not know when we'd be far enough along on the issues for that participation to make sense. Mr. Gold asked if this was a direction the administration was working towards. Mr. Wells stated he is not in a position to speculate on that.

Mr. Bahn, of TGV Rockets, noted that the administration was conducting the CRuSR program very well. It has the potential to be highly disruptive. If the administration pushed more disruptive innovations, it might be able to get more bang for the buck. Mr. Wells asked if "disruptive" meant different ways of tackling problems. Mr. Bahn stated that the meaning he used was changing values. The orbital launch community looks at dollars per pound to orbit. Disruptive technology might look at dollars per pound to 100 kilometers. Mr. Wells stated there are elements in the President's plan for NASA that have been retained through CRuSR and through some technology R&D investments they hope to make. He thanked Mr. Bahn for his point of view.

Mr. Culbertson asked if Mr. Wells thought the legislation that just passed supported the President's space policy. Did Mr. Wells think that the policy is sustainable given the constraints that are coming on discretionary spending in the coming years? The second question concerns the statement in the policy to go to an asteroid beyond the moon by 2025, but, in the meantime, go to the space station. There's not much in between. If NASA or the community were to decide we needed to go to the moon to learn how to go to an asteroid, would that be precluded under this administration?

Mr. Wells noted that earlier in the year the President laid out a plan for NASA that contains a broad range of themes and priorities. These would put NASA on a more stable, but still worthwhile, path going forward. Mr. Wells stated that many of those priorities are supported in the legislation. Mr. Culbertson wanted to know if the President is going to continue to support NASA at the level set for this year. Mr. Wells noted that this support is a priority, but he could not speculate about the future.

Mr. Koller, of SpaceTec, stated that he heads an organization that trains and certifies aerospace technicians across the country. He's been asked why we are training people if there aren't any jobs. He noted that it is an interesting time for aerospace and he feels that the policy is the most important issue in the country's space program. He asked if there's anything on the education side his organization can do to help, please call on it.

Mr. Wells thanked everyone for their interest and for their questions.

Mr. Trafton thanked Mr. Wells for his remarks.

Mr. Trafton then introduced Jim Muncy, of XCOR, who was filling in for Brett Alexander and Jeff Greason. Mr. Muncy gave the report from the Reusable Launch Vehicle Working Group.

Reusable Launch Vehicle Working Group (RLVWG)

Mr. Muncy reported that there had been two presentations to the RLV Working Group. John Sloan and Megan Mitchell of AST staff gave an update on their activities with the International Astronautical Federation (IAF) Commercial Spaceflight Safety Committee. That was followed by a presentation from Mr. McAlister on the status of the NASA Commercial Crew Initiative.

Mr. Muncy noted that the IAF Commercial Spaceflight Safety Committee was created in 2008. Its purpose is to identify and discuss issues. It is not a standards or regulation committee; nor is it a negotiating group. People in the IAF were talking separately about developments in the United States, especially those surrounding commercial spaceflight and space tourism. There was a concern about regulating and certifying this type of spaceflight. The FAA took a leadership role on behalf of U.S. industry to start a dialog. It formed this committee to allow people to talk with each other and learn more about why the U.S. is doing things the way it is doing them. Many of the international community are interested in modeling their activities after the U.S.

Mr. Muncy stated that the FAA/AST chairs the committee. The co-chairs are Swedish Space Corp. and Virgin Galactic. There are approximately 50 members. The third official meeting was held in Prague about a week before this COMSTAC meeting. They identified initial themes for papers and workshops. The number one issue that arose was, which rules apply to space? Space and air traffic management is also a big issue. Other issues under discussion are spaceports, reentry, and the future markets of point-to-point travel. They also discussed medical issues that do not overlap with other IAF committees. They will not deal with environmental or technology control issues. The committee is looking at holding a legal issues workshop, perhaps in conjunction with the FAA/AST annual conference in February. Mr. Muncy noted that there seems to be a significant interest in replicating all or part of the U.S. approach He stated that the FAA is doing a great job of balancing assistance to foreign spaceports that will be customers of U.S. vehicle developers while not appearing to create unfair competition with U.S. spaceports. Mr. Muncy observed that the International Space Transport Association announced itself in September and held a short meeting in Prague. They are an industry group in Europe to lobby in Europe for a more open approach, such as exists in the U.S. They held one panel session and plan to hold others next year in Cape Town.

Mr. Muncy turned to a discussion of Mr. McAlister's presentation. That presentation homed in on the issue of an insight and oversight approach to commercial crew reliability and safety. There are two goals to NASA's commercial crew initiative. One is the need for NASA to have safe, reliable, and cost-effective crew transport for astronauts to the ISS. The second is to stimulate non-NASA markets for this capability. NASA is looking at the commercial space industries that might be possible with a broad and competitive and dynamic commercial crew capability. Both goals require a different approach from NASA's traditional paradigm for human spaceflight.

Mr. Muncy described insight as the capacity to discern what's going on with a project and the efforts to bring the project to completion. That's modeled as a cooperative partnership between NASA and its commercial partner. There may be a number of NASA people on-site with the partner as technical members of the team. Oversight is the

more traditional top-down management of a commercial partner's development, test and operations efforts. How this is done depends on the commercial partner's approach to commercial crew capabilities. An existing launch vehicle with a long track record will have a different level of insight than a totally new launch vehicle. There will be set safety requirements and standards that providers will have to meet before NASA will fly astronauts on the vehicles. However, NASA would not manage a commercial partner's engineering processes. Mr. Muncy asked for any questions.

Mr. Bray asked how this approach was different from what NASA did under the Goldin Administration with respect to commercial providers and trying to reduce cost and oversight. Mr. Muncy responded by using the X-33 program as an example. That program had people from NASA working in the program, contributing technically on a team. It was not what Mr. Muncy would call a bottom-up approach. It was an attempt to impose smaller, cheaper, faster on a standard bureaucratic system.

Mr. Bray had a second question. He asked if there had been consideration or discussion regarding what happens if the market wants something different from what NASA wants. Mr. Muncy stated that Mr. McAlister did not get into that issue. Mr. Muncy did say that one of his clients is Space Adventures. The number one thing that people signing up for a flight to space want is to come back. Therefore, safety is very important. At some point there will be multiple private partners working with the government. They will have to make sure their operations are as safe and reliable as possible. With more people going into space, there are more chances of problems. Ultimately there will be a bad day. The question is, can we have a robust enough system such that it will learn and grow and move forward? Mr. Muncy closed his remarks.

Mr. Trafton thanked Mr. Muncy for his report. He then introduced Mike Gold, Director of D.C. Operations & Business Growth for Bigelow Aerospace, to report on the Export Controls Working Group.

Export Controls Working Group (ECWG)

Mr. Gold began his remarks with some background. Export control is very complex. There are two lists: the United States Munitions List (USML) that includes all the military stuff, and the Commerce Control List (CCL) that includes more benign commercial technology. The problem is that you can have the same technology on both lists being treated completely differently. Mr. Gold did praise the people at the Directorate of Defense Trade Controls (DDTC) and the Defense Technology Security Administration (DTSA) for their efforts to make the system work better. He went on to state that our ITAR rules get in the way of good international relations with countries where we want to do business.

Mr. Gold how confused and unclear the export control arena had become and therefore, assembled a panel of experts to provide clarity and up-to-date information. This panel consisted of Maureen Tucker from the Department of State, Tony Dearth from the DDTC, and Thomas Moore, the lead Republican staffer for the Senate Foreign Relations Committee.

Mr. Gold went on to describe the "four singles" plan put forth by the Administration. We currently have two lists and four agencies involved in export control. The four singles

proposal is a single list, administered by a single agency, tracked by a single IT system, and under a single licensing agency. This was discussed at the previous COMSTAC meeting.

The Administration now proposes to apply a three tiered system to the USML and CCL in order to distinguish the types of items and services that should be subject to stricter or more permissive levels of control for various end uses and end users.. The two lists would be structurally aligned so that they can eventually be combined into a single list of controlled items. The highest tier would be comprised of items and services that provide a critical military or intelligence advantage to the United States and are available almost exclusively from the U.S.. . They would require a license. The middle tier would still consist of items with substantial military or intelligence advantage to the U.S.but are available almost exclusively from partners and allies. Many of these items will be authorized for export under license exemptions. The lowest tier would include items that provide a significant military or intelligence advantage but are available more broadly. These items will generally not require a license for export to most destinations.

The Administration applied this tiered process to Category VII, tanks and military craft. They found that 74 percent of the 12,000 items that were licensed last year in the category would be moved to the CCL or decontrolled entirely. Of the remaining 26 percent, 18 percent would be placed in the middle tier and only 8 percent in the lowest tier. Mr. Gold noted that brake pads used for a tank are controlled under USML. The exact same brake pads for fire engines are on the CCL. He asked, if you are shipping brake pads, what are you supposed to do?

During the panel discussion, Mr. Gold stated that there did appear to be potential conflict between the Administration and Congress, and that some Members of Congress feel that the current regime does a very good job of non-proliferation generally and keeping technology from China specifically.

Mr. Gold expressed his gratitude to the panelists who took a lot of very challenging questions. Despite the Administration's best efforts, Mr. Gold was pessimistic that Congress would address export control reform legislation due to a lack of consensus and priority. He asked if there were questions.

Mr. Holder stated that Mr. Gold had given a very engaging presentation and exemplified the tiers pretty clearly. The one thing we have to do is to communicate to Congress that certain changes are good for us and why. A coherent message from the aerospace industry on why this is good to both sides of the aisle could be a pathway to achieve a more reasonable export control regulatory environment. The challenge is how to make sure that a coherent and consistent voice is heard in Congress. It's an issue that affects the survival of our industry and our ability to interact internationally and continue to lead internationally.

Mr. Gold responded with how he saw the positions of Republicans and Democrats. The Working Group has put forth recommendations on elements like the four singles plan. He expects the tiered system will be introduced in Congress next year. When that happens, the Working group will come back with recommendations for COMSTAC to support it.

Mr. Szoka asked if Mr. Gold saw any hope of there being someone on the right after the election who would be willing to step up and take on this cause. Or what can we do to find and convince that person to do so?

Mr. Gold indicated that when the issue of export control comes up in Congress, the Defense Department states that this is a defense issue.

Mr. Huntsman, of the commercial space staff at NASA, referred back to Mr. Holder's question on the industry getting behind the export control issues. He asked if there was truly an aerospace industry consensus on this. Mr. Gold responded that he thought the associations have come to a point where they support changes in export control. This has occurred in the last two or three years. Additionally, Mr. Gold noted that while small companies can have more difficulty in coping with export controls than large companies, both Boeing and Lockheed Martin have been interested in and supportive of reform efforts.Lockheed and Boeing have been supportive of the export control reform movement.

Mr. Barber, of AIAA, noted that there are AIAA members involved with export control and a lot of hard work is being done by the associations working together to influence Congress's thinking.

Mr. Gold praised AIAA's efforts, then closed his comments.

Mr. Trafton thanked Mr. Gold for his presentation and for convening the panel at the working group meeting. He asked Mr. Gold to work over the next six months through conference calls and the working group to generate something that COMSTAC could pass on to FAA/AST as an actionable item on this issue.

Mr. Trafton dismissed the meeting for a ten-minute break.

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When the meeting reconvened, Mr. Trafton introduced Jim VanLaak to moderate the public forum portion of the meeting. Mr. VanLaak had no prepared comments and immediately opened the meeting to questions from the public. There were no questions.

Mr. Trafton encouraged people to submit comments to the COMSTAC at any time. He noted that the next meeting will be in May 2011.

Mr. Trafton adjourned the meeting at 2:19 p.m.

Signed by

Wilbur C. Trafton Will C Trafton 1/26/2011

Chairman, COMSTAC

COMSTAC Members Present

1. Wilbur C. Trafton, Will Trafton & Associates, COMSTAC Chair
2. Eleanor Aldrich, American Institute of Aeronautics and Astronautics
3. Daniel Collins, United Launch Alliance
4. Frank Culbertson, Orbital Sciences Corporation
5. Robert S. Dickman, American Institute of Aeronautics and Astronautics
6. Michael N. Gold, Bigelow Aerospace
7. Louis R. Gomez, New Mexico Spaceport Authority
8. Livingston L. Holder, Jr., Holder Aerospace
9. Timothy Hughes, Space Exploration Technologies Corporation
10. Christopher Kunstadter, XL Insurance, COMSTAC Deputy Chair
11. Debra Facktor Lepore, DFL Space LLC
12. James Muncy, XCOR, for Brett Alexander and Jeffrey Greason
13. Charles Precourt, ATK Launch Systems
14. Dr. Billie M. Reed, Virginia Commercial Space Flight Authority
15. Janet Sadler, Chartis Insurance UK Limited
16. Berin M. Szoka, Space Frontier Foundation
17. John W. Vinter, Consultant

Federal Aviation Administration Representatives

Dr. George C. Nield, Associate Administrator for Commercial Space Transportation

James Van Laak, Deputy Associate Administrator for Commercial Space Transportation

Susan M. Lender, COMSTAC Executive Director, Federal Aviation Administration