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Statement of
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before the

Committee on Science, Space and Technology
U. S. House of Representatives

Mr. Chairman and Members of the Committee, thank you for the opportunity to appear before you today to discuss NASA's efforts to support the development of commercial crew transportation systems. We are pleased with the progress our industry partners have made in this new and innovative approach to human spaceflight development. Their success is critical to ensuring that we re-establish an American capability to transport U.S. astronauts – and their cargo – to the International Space Station (ISS), and quickly end the outsourcing of this work to foreign governments. And they need robust funding from NASA, to achieve timely success in this critical endeavor. Not only will the availability of one or more commercial crew transportation systems represent the emergence of a brand new domestic capability for carrying our astronauts to Low Earth Orbit (LEO) and the ISS, it will also enable the Agency to focus on developing its own systems for sending astronauts on missions of exploration beyond LEO.

Commercial Crew Development (CCDev)

NASA's investments have been aimed at stimulating efforts within the private sector to develop and demonstrate human spaceflight capabilities through the CCDev initiative. Since 2009, NASA has conducted two CCDev rounds, soliciting proposals from U.S. industry participants to further advance commercial crew space transportation system concepts and mature the design and development of elements of the system, such as launch vehicles and spacecraft. In the first round of CCDev, NASA awarded five funded Space Act Agreements (SAAs) in February 2010, which concluded in the first quarter of 2011. Awardees and the amounts of the awards were: Blue Origin, $3.7 million; the Boeing Company, $18 million; Paragon Space Development Corporation, $1.44 million; Sierra Nevada Corporation, $20 million; and United Launch Alliance, $6.7 million. Under these SAAs, companies received funding contingent upon completion of specified development milestones. All milestones were successfully accomplished by the CCDev industry partners.

During the second CCDev competition, known as CCDev2, NASA awarded four funded SAAs that are currently being executed with the following industry partners:

- Blue Origin's work involves risk-reduction activities related to development of a crew transportation system comprised of a reusable biconic shaped Space Vehicle launched first on an Atlas V launch vehicle and then on Blue Origin's own Reusable Booster System. The company is working to mature its Space Vehicle design through Systems Requirements Review (SRR), maturing the pusher escape system, and accelerating engine development for the Reusable

Booster System. As of September 30, 2011, Blue Origin had successfully completed five of ten milestones and NASA had provided $11.2 million of the $22 million planned for this effort.

- The Boeing Company is maturing its commercial crew transportation system through Preliminary Design Review (PDR) and performing development tests. Boeing's system concept is a capsule-based spacecraft reusable for up to ten missions that is compatible with multiple launch vehicles. Boeing's effort will include launch abort engine fabrication and static test fire, landing air bag drop demonstration, wind tunnel testing, parachute drop tests, Service Module Propellant Tank Development Test, and Launch Vehicle Emergency Detection System/Avionics System Integration Facility Interface Simulation Test. As of September 30, 2011, Boeing had successfully completed five of fifteen milestones and NASA had provided $52.5 million of the $112.9 million planned for this effort milestones.

- Sierra Nevada Corporation (SNC) is maturing its commercial crew transportation system, the Dream Chaser, through PDR with some subsystems to Critical Design Review (CDR). The Dream Chaser is a reusable, piloted lifting body, derived from NASA's HL-20 concept that will be launched on an Atlas V launch vehicle. SNC's effort also includes fabrication of an atmospheric flight test vehicle, conducting analysis and risk mitigation, and conducting hardware testing. As of September 30, 2011, SNC had successfully completed four of thirteen milestones and NASA had provided $30 million of the $105.6 million planned for this effort.

- SpaceX is maturing its flight-proven Falcon 9/Dragon transportation system focusing on developing an integrated, side-mounted Launch Abort System. The uncrewed version of Dragon is already being demonstrated as part of the Commercial Cargo project, and will be used operationally as part of the ISS cargo resupply services effort. Their crew transportation system is based on the existing Falcon 9 launch vehicle and Dragon spacecraft. The Launch Abort System, an essential safety-critical system, represents the longest-lead portion of the Falcon 9/Dragon crew transportation system. As of September 30, 2011, SpaceX had successfully completed four of ten milestones and NASA had provided $40 million of the $75 million planned for this effort.

In addition to the four funded agreements mentioned above, NASA has also signed SAAs without funding with three companies: Alliant Techsystems, Inc. (ATK); United Launch Alliance (ULA); and Excalibur Almaz, Incorporated (EAI). The ATK agreement is to advance the company's Liberty launch vehicle concept. The ULA agreement is to accelerate the potential use of the Atlas V as part of a commercial crew transportation system. The EAI agreement is to further develop the company's concept for LEO crew transportation. As of September 30, 2011, ATK had successfully completed one of five milestones; ULA successfully completed two of five milestones. NASA and EAI are initiating activities under the SAA now, and milestones are planned to continue through May 2012.

Commercial Crew Program (CCP)

The CCP is a partnership between NASA and the private sector to incentivize companies to build and operate safe, reliable, and cost effective commercial human space transportation systems. In the near term, NASA plans to be a reliable partner with U.S. industry, providing technical and financial assistance during the development phase. In the longer term, NASA plans to be a customer for these services, buying transportation services for U.S. and U.S.-designated astronauts to the ISS. We hope that these activities will stimulate the development of a new industry that will be available to all potential customers, including the U.S. Government.

Success of the CCP would also end the outsourcing of space transportation to foreign providers. Together with the capabilities to explore deep space provided by the Space Launch System and the Orion Multi-Purpose Crew Vehicle, NASA is moving forward on a robust, comprehensive U.S. human spaceflight program. Reductions from the President's FY 2012 requested funding level would affect our ability to successfully implement this program's procurement strategy, and could leave us dependent on foreign transportation services for a longer period of time at a cost of approximately $480 million per year. The success of this program will ensure that U.S. companies will provide these services.

Commercial Crew Program Acquisition Roadmap

The CCP acquisition lifecycle is comprised of an overall hybrid structure that originated with the funded SAAs for subsystem, system and element design during the separate CCDev efforts, to be followed by a series of competitively awarded contracts for an integrated Crew Transportation System (CTS). NASA's review and analysis led to the development of a phased acquisition strategy incorporating separate, sequential, full and open competitions, tailored to meet the Program objectives throughout each phase of design, development, test, evaluation, certification, and ISS transportation services. A combination of funded agreements and contracts for separate phases was determined to be the ideal strategy to capitalize on the strengths of each in the appropriate lifecycle phase, while balancing technical, schedule and cost risks. Figure 1.0 illustrates the overall hybrid approach for the CCP acquisition strategy.

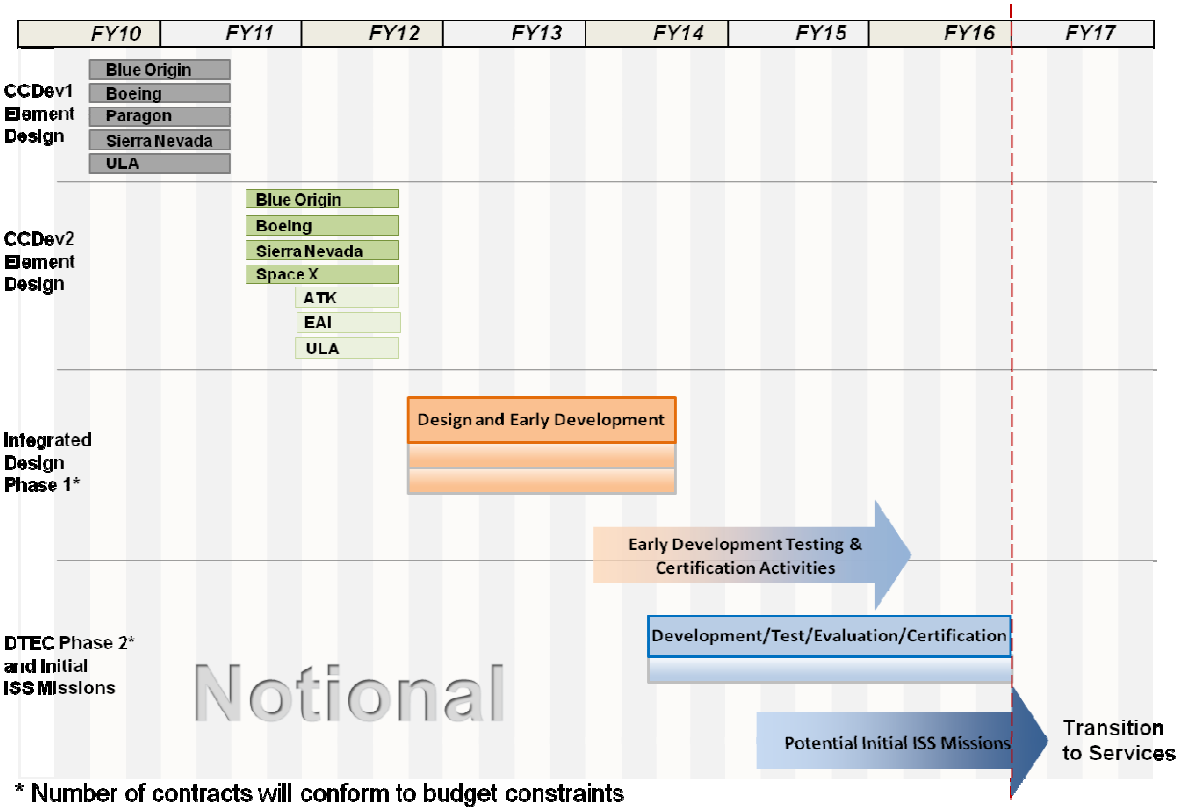

Figure 1.0 – Commercial Crew Acquisition Roadmap

CCP's acquisition approach focuses on reducing the risk and uncertainty of the development cycle and on the incentives provided through competition by separating the design and early development content (Phase 1) from the longer-term Development, Test, Evaluation, and Certification (DTEC) activities (Phase 2). This multi-phased approach provides a shorter period of performance for the Phase 1 contract, thereby limiting the potential financial risk involved in utilizing long periods of performance with multiple commercial partners. Separating the early design from the longer-term development also provides a phased approach to cost assessment and management. The separation between Phase 1 and Phase 2 is distinctly defined to finalize design requirements in Phase 1, prior to a financial commitment to invest in the required capital assets associated with development and testing. Additionally, the approach encourages competition among multiple companies at each stage, which results in lower costs for each lifecycle phase and allows for well-timed incorporation of lessons learned.

On September 19, 2011, NASA released a draft Request for Proposals (RFP) for Phase 1, entitled Commercial Crew Integrated Design Contract (CCIDC), inviting industry to comment on the process. The final CCIDC RFP will incorporate input from industry as appropriate and solicit proposals for a complete end-to-end crew transportation system design, including spacecraft, launch vehicles, launch services, ground and mission operations and recovery. NASA plans to release the final RFP for this effort by the end of 2011. The Agency anticipates that one or more operational CTS will be available for the transportation of astronauts to and from the ISS – as well as the provision of rescue services – by the middle of this decade, assuming that the CCP is funded at the requested level. Competition among multiple partners is a fundamental aspect of the strategy. Competition incentivizes performance, supports cost-effectiveness, and eliminates NASA dependence on a single provider.

Human Rating/Safety

The commercial crew program represents a shift in near Earth operations to the private sector, freeing NASA (and NASA's limited resources) to pursue other human space flight goals, including utilizing the Space Station and setting out on missions of exploration.

Within this new paradigm, NASA will maintain its stringent safety requirements and standards. We have always used contractors to build our space systems. In these programs, we are planning to use an acquisition approach that will allow the contractors more freedom to pursue cost-effectiveness, but still allow NASA the appropriate level of insight and oversight to ensure that the systems will be safe. Developing crew transportation systems to achieve LEO does not require any significant technological breakthroughs which is a key factor in using a unique insight/oversight approach. We will maintain crew safety by way of a crew transportation system certification, and no system will receive this certification until NASA has confidence that our personnel will be safe.

NASA is committed to managing the requirements, standards, and processes for CTS certification to ensure that commercial missions are held to the same safety standards as Government missions. NASA will be responsible for defining, managing, reviewing and approving certification plans and verification closure of requirements related to CCP missions.

To implement the lessons learned from Apollo, Challenger, and Columbia relative to the independent oversight of design, test and certification, CCP will map program processes to the Agency's programmatic guidelines for all NASA spaceflight programs (NASA Procedural Requirements 7120.5, NASA Space Flight Program and Project Management Requirements) while working to minimize bureaucratic hurdles. These processes will include independent review of the commercial providers' performance of key milestones and major technical risks to crew safety. NASA CTS certification will evaluate and assure that the commercial provider's CTS design and implementation can safely conduct

the required crew transportation mission. NASA CTS certification includes evaluation of design features and capabilities that accommodate human interaction with the CTS to enhance overall safety and mission success. NASA, through our CTS certification process, is fully accountable for the safety of the NASA crew on CCP missions.

The underpinning of the certification process is the CTS requirements. To date, NASA's CTS requirements have matured considerably. On May 21, 2010, NASA released its first version of commercial human rating requirements to industry in a document titled *Commercial Human Rating Plan (CHRP)*. Through a Request for Information, NASA received extensive and valuable feedback on the CHRP and incorporated that feedback, along with refined NASA understanding and planning, into the preparation of the next release of the requirements.

In response to the release of CHRP, industry identified that there was a lack of clarity about the Agency's approach to certifying commercial transportation systems. As a result, NASA released the *Commercial Crew Transportation System Requirements for NASA LEO Missions* to the public on December 10, 2010. This document provides requirements, standards and processes that will be applied to any NASA or NASA-sponsored commercial crew transportation mission to LEO.

CCP currently is refining the requirements identified in the *Commercial Crew Transportation System Requirements for NASA LEO Missions* into several documents to clearly communicate NASA's requirements, standards, and processes for CTS certification. The clarification provided by these documents will allow NASA and industry to ensure all necessary requirements, standards, and processes are met by commercial partners to safely transport NASA and NASA-sponsored crewmembers to the ISS. CCP refers to the program-level requirements as the "1100-series" documents, which are depicted in Figure 2.0. The initial public release of a subset of the program-level requirements was accomplished on October 25, 2010, along with the announcement for CCDev 2.

The second release of the 1100-series documents to industry occurred on April 29, 2011. As a result, all program-level requirements and standards were made available to industry for review and comment. CCP hosted a requirements workshop with industry on May 24-25, 2011 to communicate the intent of the documents, and to continue a dialogue with industry with respect to the documents.

NASA provided a third release of the 1100-series documents in conjunction with the draft Request for Proposals (RFP) for the Integrated Design Contracts on September 19, 2011, followed by another requirements workshop with industry on October 4, 2011. Baseline versions of the 1100-series documents are expected to be released to industry in December 2011 in conjunction with the final RFP for the Integrated Design contracts.

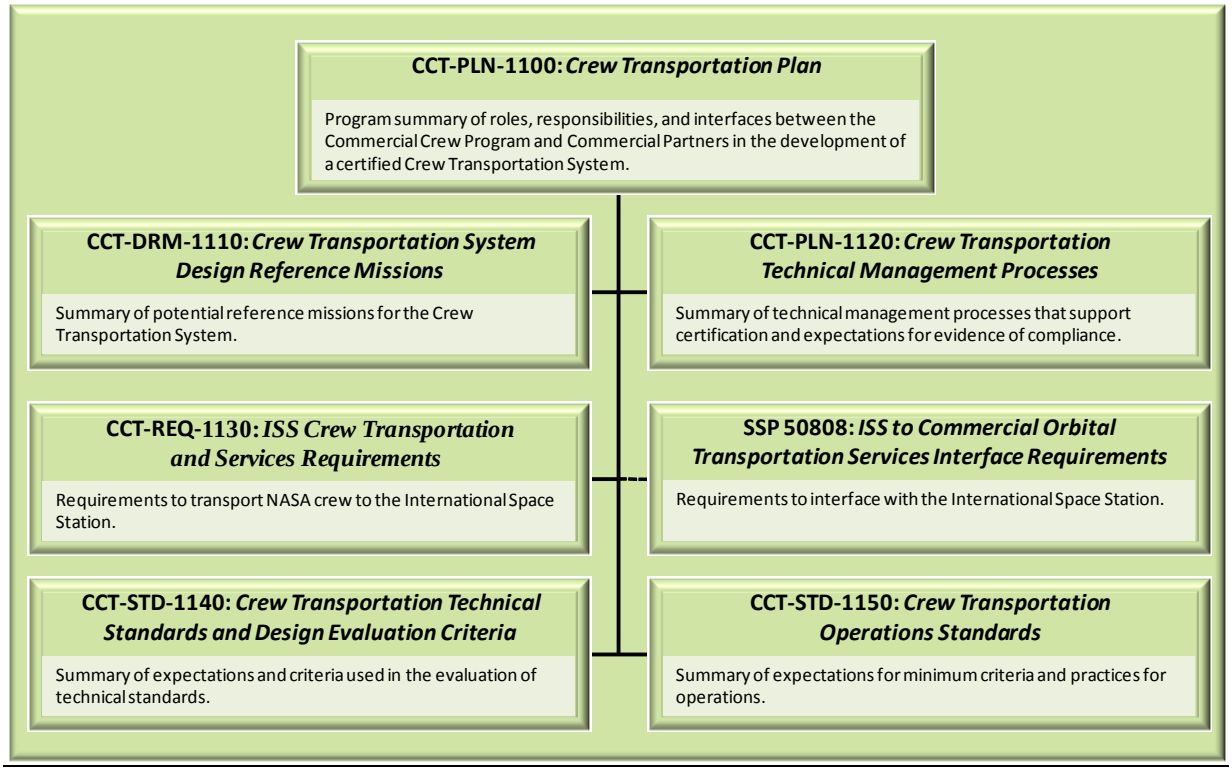

Figure 2.0 – 1100-Series Documentation

As an additional "check and balance" in the area of safety, all CCP activities will be subject to evaluation by organizations independent of and funded separately from CCP, including the NASA Safety and Mission Assurance independent technical authority, the NASA Space Flight Safety Panel which is chaired by a member of the Astronaut Office, and the NASA Aerospace Safety Advisory Panel.

Coordination with the Federal Aviation Administration (FAA)

Both NASA and the FAA envision a state where the FAA licenses commercial human spaceflights provided by a robust industry, from which NASA and the private sector can purchase transportation services. The requirements and processes of these separate agencies must be carefully coordinated and aligned to assure that both Agencies' roles are accomplished with thoroughness and rigor. At the same time, it will be critical to the success of the industry ventures to minimize the burden of Government requirements and regulations imposed by multiple agencies.

The nature of the FAA involvement in NASA's commercial crew activities will vary through the development and operation of each potential flight system. NASA will establish initial certification and operations requirements for the services it wishes to acquire from commercial providers. NASA will partner with the FAA for the purposes of determining common standards and uniform processes to ensure both public safety and protection of crews and spaceflight participants for the NASA-sponsored missions. NASA and the FAA will work towards minimizing the duplication of requirements, developing a streamlined process and addressing indemnification issues.

This will be accomplished by clearly defining roles and responsibilities of each Agency, sharing relevant data and jointly performing assessments to enable the commercial partner to be successful in support of NASA-sponsored missions and non-NASA commercial human spaceflight missions. NASA and the FAA are in the process of documenting agreements that solidify each Agency's commitment to this partnership.

Budget and Recent Accomplishments

NASA has been told consistently by a broad range of potential providers that private sector partners expect to be able to achieve the capability to provide commercial spaceflight services to the ISS within 3-5 years from initial development start. NASA's FY 2012 budget request of $850 million for CCP would provide that initial start in FY 2012 for the development of commercial crew transportation systems which NASA believes would enable services to ISS to be possible in the 2016 timeframe. A reduction in funding from the President's request could significantly impact the program's schedule, risk posture, and acquisition strategy. NASA's *initial* analysis shows that a FY 2012 funding level of $500 million (consistent with the 2010 NASA Authorization Act) would delay initial capability to ISS to 2017, assuming additional funding is available in the out-years. During that roughly one-year period of delay, NASA would be paying approximately $480M to Russia for crew transportation services. NASA remains concerned about potential reductions to the CCP budget and the anticipated schedule delays and additional costs that they will cause. NASA therefore requests sufficient funding for the CCP to avoid delaying the development of U.S. crew transport capabilities and lengthening the period during which the United States will need to pay Russia to transport crew to the Space Station.

It is worth noting that subsequent to the passage and signing of the 2010 NASA Authorization Act in October 2010, several milestones or similarly important events have occurred which shed new light on the importance, viability, and criticality of NASA's commercial crew efforts.

In April 2011, NASA completed its CCDev agreements with five industry partners. These agreements yielded significant progress on multiple commercial crew transportation concepts for a relatively modest $50 million investment from NASA. Under CCDev, U.S. private industry was able to mature long-lead capabilities that accelerated commercial crew transportation concepts.

As part of CCDev, NASA received and reviewed over 20 proposals from U.S. companies, ultimately making four awards in April 2011. NASA was very impressed with the quality of the proposals which suggested that, given the right investment and appropriate schedule, multiple U.S. companies could develop safe, reliable, and cost effective commercial CTS.

In December 2010, the SpaceX Falcon 9 rocket successfully launched for the second time and the accompanying Dragon spacecraft successfully orbited the Earth and safely returned to the Pacific Ocean. This achievement helps demonstrate the viability of the Government/private sector partnerships like the one envisioned for commercial crew and provided further evidence that innovative approaches to spacecraft development efforts can be successful, and considerably less expensive than traditional NASA procurements. However, significant work still remains for delivery of cargo to ISS. The commercial companies are continuing to make sound progress in these activities. I expect to see cargo demonstrations in the next several months.

Lastly, on August 24, 2011, Russia's Progress 44 cargo vessel crashed in Siberia after the third stage of its Soyuz rocket failed. That rocket is similar to the one NASA depends on to transport astronauts to the ISS. A Russian commission recently pinpointed the Soyuz problem as a quality-control issue, not a major design flaw. NASA concurs with that assessment. However, the failure emphasized the need to have a

robust capability to transport and provide rescue services for our ISS astronauts. Currently, we have three systems to carry cargo to the ISS, and that number will soon expand to five when Orbital Sciences and SpaceX are successful in completing their systems. However, we only have one system to rely on, the Russian Soyuz, to transport and provide rescue services for our ISS astronauts. If that system is unavailable for any reason for a significant length of time, there can be serious impacts to the productivity of the ISS.

Challenges

Currently, the biggest challenge confronting commercial crew developers as they attempt to develop and demonstrate their systems is financial. This challenge has been consistently cited as the top risk to commercial crew development and NASA's financial commitment is critical to mitigating this risk. For example, in the fall of 2009, the Augustine Report concluded, "…unless NASA creates significant incentives for the development of the [commercial crew] capsule, the service is unlikely to be developed on a purely commercial basis."

NASA's CCP is designed to reduce the risk for private industry by providing significant financial (and technical) assistance for the development of these systems. NASA believes that by providing both assistance in the system development and demand for the service, the "business case" for commercial human spaceflight providers can close for one or more U.S. aerospace companies in a manner that also yields a safe and cost-effective capability for meeting NASA's crew transportation needs.

For these reasons and the timing issues discussed earlier, it is important that the Congress provide robust funding for NASA's commercial crew initiative. This political and financial commitment from the Congress will also reduce the risk for private industry. This Congressional support will support industry in obtaining investment capital above the amount provided by NASA.

In addition to financial challenges, each of the commercial crew developers has unique technical challenges associated with its system. Given NASA's current understanding of the state of the commercial crew development efforts, the Agency is confident that the commercial crew developers can overcome these challenges. However, in order to mitigate the risk associated with technical challenges, NASA plans to support multiple commercial providers, thereby insulating the Agency in the event a commercial provider cannot complete its development effort. In addition, NASA plans to be fully supportive of in the commercial development activities, providing technical assistance, lessons learned, and past experience and knowledge in the area of human spaceflight development and operations.

A final challenge is balancing the need for NASA involvement in order to obtain a safe and reliable system and allowing the providers the freedom to seek innovative and cost effective solutions. Striking the right balance will be key to successful and timely delivery of the crew transportation systems.

Conclusion

The Commercial Crew Program has great promise, but also some significant challenges ahead. Human spaceflight is a very difficult endeavor, and our industry partners will have the responsibility for the full end-to-end system.

We cannot guarantee their success; however, we can structure an approach that provides the highest probability of success. I believe the approach outlined by NASA provides a solid path for developing and

acquiring crew transportation services in a manner that is cost effective, and provides for crew safety. We need your support to provide the funding required for this effort.

In July the Space Shuttle Atlantis rolled to "wheels stop" signifying the end of Space Shuttle operations. But, it also signaled the end for now of the ability of the U.S. to transport its astronauts into space, leaving the Nation dependent on the Russian Soyuz for crew transportation to the ISS. The CCP seeks to ensure that American companies will transport our crews to the ISS by mid-decade and that aerospace jobs and taxpayer dollars remain here in America.

The CCP is the Nation's primary strategy for ending sole reliance on the Russians for crew transportation capability to the Space Station. Private enterprise and affordable commercial operations in LEO will enable a truly sustainable step in our expansion into space—a robust, vibrant, commercial enterprise with many providers and a wide range of private and public users will enable U.S. industry to support NASA – and other Government and commercial users – safely, reliably, and at a lower cost. This is the ultimate goal – one that I believe unites all of us.

Mr. Chairman, I would be happy to respond to any question you or the other Members of the Committee may have.