REMARKS FOR ADMINISTRATOR BOLDEN

AIAA AVIATION 2016

"Concept to Reality: Our Journey to Transform Aviation"

June 17, 2016

It's wonderful to be here with the aviation community again and to be speaking at another AIAA conference.

I've never had the privilege before of being the "closer," but I know it's the last day of a busy week, so I'll kick off my remarks with this short video.

[VIDEO (1:50)]

You know I have a special fondness for everything NASA does in Aeronautics and by extension everything you all are doing to improve our air travel system and make the breakthroughs in technology from which we'll all benefit.

Since I became NASA Administrator, I've watched and tried to support the AA for ARMD, Dr. Jaiwon Shin, and his incredibly visionary team as they have led NASA and the aeronautics community in making great progress on the goals we all share. NASA has also laid out some stretch goals that will keep us all striving for more and keep the momentum going. We have a strategic plan, but just as in space exploration, there's no graduation day. We reach milestones and then we build on them to go even further.

As I've said many times, and I know I'm preaching to the choir, Aeronautics is a cornerstone of economic prosperity and is critical to maintaining our national security and defense.

Today, I want to talk to you a bit about how far we've come in the past few years and where we're headed, because I like to envision that we're on a continuum and we never stop!

I'm very excited about the future because in aeronautics, as in everything at NASA, we're about making the impossible possible. In aeronautics, we've been taking concepts and making them reality. Between NASA and its predecessor, the NACA, we're building on more than 100 years of research, which is certainly an incredible body of knowledge with vast implications for what comes next.

When I became NASA Administrator nearly 7 years ago, there was a lot of promising work already unfolding and more was on the horizon. Today, we've reached a lot of those horizons and are already looking toward the next ones.

Our contributions are both visible -- such as winglets and composite structures – and behind the scenes, such as software tools for more efficient air traffic management. Whatever the technology, "NASA is with you when you fly."

Recent successful completion of eight ‘green aviation’ technology demonstrations by our Environmentally Responsible Aviation, or ERA, project have shown we are at the right place, at the right time, with the right technology to open a truly revolutionary era of aviation not seen since the dawn of the commercial jet age during the 1960s.

One ERA demo took a 30-foot multi-bay composite aircraft structure to the breaking point and beyond in a series of stress tests, proving it could withstand the forces it would experience in flight, even in the most violent turbulence.

The structure’s unique “stitching” technique could make it possible for us to build aircraft with new shapes, such as a hybrid wing body.

That composite material is also light, which saves fuel and helps cut emissions. If any tears or holes develop, the unique design would arrest the damage and prevent it from getting worse. Now that's something I didn't have in test pilot training.

The ERA project also worked with industry partners to demonstrate a number of propulsion innovations, like a change in the design of a turbine engine's compressor stage that improved fuel efficiency by 2.5 percent. The project also made refinements to a geared turbofan jet engine that could reduce fuel burn by 15 percent and significantly reduce noise. Improvements to a jet engine combustor design reduced nitrogen oxide production by nearly 80 percent.

Now we need to bring those concepts on which we've been working from the developmental stage to full-fledged reality if we are to solve the growth-related challenges facing the global aviation community during this first half of the 21st century.

These challenges stem from the demand to fly more passengers, more cargo, on more airplanes and at the same time use less fuel, produce less emissions and generate less noise.

It's a tall order, but I know we're up for it.

If industry adopts technologies on which our partners and we have been working during the past 10 years, future aircraft could cut fuel use in half, cut emissions by 75 percent and cut noise to nearly one-eighth of today's regulated limits. It's possible, according to our computer models, that airlines could save more than $250 billion dollars between 2025 and 2050.

NASA's Aeronautics roadmaps, which we briefed here on Tuesday, identify how we and the aviation community would work on solutions to challenges in mobility, autonomy, safety and efficiency during the next 10, 20, and even 30 years.

To begin that work, NASA has developed a bold 10-year research plan that lowers the risk for industry to adopt these solutions, accelerates the pace of adoption and achieves revolutionary breakthroughs in new aircraft and air traffic management technologies.

The centerpiece of the plan is New Aviation Horizons (NAH), an initiative that calls for our return to flying experimental technology demonstrators, known among aviation enthusiasts as X-planes. We expect there will be five mostly large-scale X-planes over the next decade that will flight-test new technologies and systems as well as novel aircraft and engine configurations. So, yes, I can affirm what many of you may have heard, NASA is returning piloted X-planes to its research portfolio as a key part of the 10-year New Aviation Horizons initiative.

Three large scale, subsonic X-planes will demonstrate in-flight the range of possible technologies and configurations that could contribute to the major reductions in fuel, emissions and noise that are among our stretch goals. Some of those enabling technologies include very high aspect ratio wings that increase efficiency, new composite structures that can support non-circular shapes like the hybrid wing body, advanced integration of airframe and propulsion in order to reduce drag and boundary layer ingestion solutions that also reduce drag.

Additionally, the X-planes give us the opportunity to test not just one technology at a time, but also multiple technologies that are ambitious, complex and visionary.

So we are counting on all of you to bring us your innovations -- the heart and soul you've always brought to the table -- in addition to your expertise and professionalism. To all of us, this work is not just a contract or a job, it means so much more.

A fourth large scale X-plane planned to fly in the mid-2020s will explore the most promising hybrid-electric propulsion and aircraft integration concepts. This is a comparatively new area of research for NASA and for the community as a whole, so we are still investigating fundamental technologies and concepts that will eventually be integrated for demonstration in a large-scale vehicle.

However, we are eager to move ahead. That is why I'm excited that we have just announced that next year we will fly a small-scale, general aviation-sized, X-plane. You heard that right, next year.

[*VISUAL WILL COME UP OF THE PLANE AND MISSION LOGO*]

This small-scale, build-and-learn X-plane has just received its official "X" designation. …. X-57 and will be called Maxwell.

It will take to the skies with 14 electric motors turning propellers integrated into a uniquely designed wing. We'll be testing new propulsion technology that could result in a five-fold reduction in the energy required for a private plane to cruise at 175 miles per hour. I like to think that James Clerk Maxwell, for whom we named the plane because of his groundbreaking work in electromagnetism and fundamental physics in the 19th century -- would be pleased, even though for him a plane would have been an incredible fantasy.

But X-57 is no fantasy. We hope to validate the idea that by distributing electric power across a number of motors integrated with an aircraft in this way we can reach those propulsion goals along with fuel savings. The technical name you may hear for the X-57 flight effort is the Scalable Convergent Electric Propulsion Operations Research project – or SCEPTOR. But now we also have -- *Maxwell*!

With the return of piloted X-planes to NASA's research capabilities as a key part of our 10-year New Aviation Horizons initiative – the X-57 will take the first giant step in opening a new era of aviation.

And because we're talking about giant steps and new eras, I want to take this opportunity to recognize a special man here today who knows what it means to be part of something brand-new, something experimental. Major General Joe Engle, "Joe," is here today as part of the Forum 360 panel right after this about hypersonic and re-entry flight testing, starting with the X-15. Joe was an Air Force pilot who flew the X-15 research rocket. He then became a NASA astronaut, eventually commanding several space shuttle flights, including the initial space shuttle "Enterprise" approach and landing test flights. So Joe has experienced what it means to try something absolutely new, and he's witnessed the way these new endeavors transform how we live and how we explore.

Thank you, Joe.

Please stick around for Joe's panel. I understand we've provided a really nice X-15 educational item for you to "roll up" and take home!

Preliminary design work has also begun on the fifth large scale X-plane, the Quiet Supersonic Technology demonstrator, or *QueSST*. With *QueSST* we're trying to design and build an aircraft that flies at supersonic speeds without the annoying sonic boom of current aircraft. We plan to provide data to federal and international regulators that could lead to new noise standards accommodating overland commercial supersonic flight.

Taken together, this decade-long plan will be NASA's "moon shot" for aviation.

We won't be able to do this alone. Our success will depend on you and your companies and a willingness to believe in this audacious future. NASA's work with the aeronautics field is one of the most productive public-private partnerships in U.S. history and along with academia and other government agencies, including the Federal Aviation Administration (FAA), the Department of Defense (DoD) and partners around the world, it's a powerful force for change and progress that will help us maintain our role as a world leader in aviation at a time of increasing global competition.

Our partnership with the FAA, for instance, is decades old and has enabled technology transfers that are the backbone of today's air traffic management system.

Just within the last few years, our new Research Transition Team has successfully transferred tools that can:

- help air traffic controllers at the busiest airports provide aircraft with more efficient descent options that use less engine power while maintaining safe distances;
- help improve overall efficiency by reducing missed or delayed departures and allowing more aircraft to depart within a given timeframe.
- allow pilots to better use automation for more efficient descents, and to work with controllers to streamline those glide paths. This most recent tool, called *TSaS* (Tee-Sass) has been approved by the FAA for full deployment.

Here's another example of our powerful partnership with industry. NASA researchers will have intimate access to airline operations over the next five years, thanks to a partnership with American Airlines that we just announced yesterday.

Engineers and scientists at NASA's Langley Research Center in Hampton, Virginia, are looking at ways to improve flight training, cockpit displays and other flight deck operations. Through the agreement they will be able to fly as observers in the cockpit during at least a half dozen round trip American flights each year to get first-hand knowledge of how flight crews work and interact with technology in real time.

I'm also looking forward next week to cutting the ribbon on a new NASA research laboratory in Charlotte with Transportation Secretary Anthony Foxx. The lab will support upcoming field tests of NextGen technologies.

These are just a few examples of the many partnerships we have with other government agencies, airports and airlines, industry and universities, which ensure our work is relevant, tackles priority concerns of the community and accelerates the transition of advanced technologies from the lab to operations.

The work we do for the New Aviation Horizons X-plane initiative will take place alongside our full portfolio of ongoing propulsion research for piloted and unmanned aircraft and especially our research into air traffic management systems to support NextGen.

In addition to NAH, we'll make complementary investments in:

- other technologies to design future aircraft systems and test them;
- exploring new concepts for advanced, high-power jet engines with smaller cores;
- assessing the feasibility of using advanced technology concepts from other sources; and
- emphasizing university leadership and direct involvement of students.

This education aspect in particular is crucial to ensuring the future U.S. workforce is positioned for global leadership.

Inspiration and the ability to join our journey are some of the key legacies this work must leave.

To date, there's been a lot of interest and support for our 10-year investment plan from both large and well-established players as well as newer and even startup companies. That combination gives us strength and stamina and also agility. It provides an entrepreneurial bent to this work and the ability for early "off-ramps" as we reach milestones and begin to spin them off into general use.

The broad-based support for our direction also includes associations, academia, other government agencies and a number of major airports.

I've flown tens of thousands of miles this year to meet and speak with space leaders and students, diplomats and politicians, educators and engineers around the world.

But I know I'm not alone in wanting to transform that experience and make breakthroughs that are applied around the globe, just as we've leapt from the Wright flier all the way to X-planes and reusable spacecraft.

The exciting thing is that this work has already begun. The President's Budget Request for 2017 was released in February, with an Aeronautics budget of $790 million and its extraordinary proposal to devote $10.6 billion over 10 years just at NASA toward a government–wide initiative for a cleaner transportation system. The community has been very supportive and many of our own researchers are eager to work on X-planes and accelerate the pace of the transformation.

Regardless of the outcome of the next budget, we will continue to focus on advanced aviation technologies and the pace of our work has only increased in the past few years.

We have a lot of the infrastructure in place to continue our leadership in Aeronautics and we have a solid base of work to take things to the next level, but we need to continue shepherding the big ideas, building a solid base and moving our concepts toward flight.

We want you to be there with us and we need your energy and advice and your innovative new technologies. I do believe that we are at the right place, in the right time, with the right technology for all of these elements to come together. Our strategic plan presents a vision for the next generation and we want you to be there with us every time we soar.

Thank you.