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INTEGRATION OF ADVANCED CONCEPTS AND VEHICLES INTO THE NEXT GENERATION AIR TRANSPORTATION SYSTEM: STUDY OBJECTIVE

NRA PRE-PROPOSAL CONFERENCE
NASA AERONAUTICS

[Moderated by Dr. John Cavolowsky, Deputy Director, Airspace Systems Program]

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P R O C E D I N G S

ARMD Research and Development

DR. PORTER: For those of you who don't know me, my name is Lisa Porter, and I am the Associate Administrator for Aeronautics. I didn't want to take a lot of time here, but I did notice that from the list of attendees that we have quite a breadth of representation, which I am quite excited about. That was our goal, but because of that, some of you probably have varying degrees of familiarity with the Aeronautics Research Program, and so I wanted to spend a few minutes covering things that I think are critically important for everyone to understand if you are considering proposing to this NRA.

So let me begin with the three core principles that are critical in our program. They are the principles that guide every single decision that we make in the Aeronautics Research Mission Directorate. So I would just like to spend just a minute on them. Some of you have seen these before. Some of you have not. I would just like to cover them briefly because they are critically important, that you understand them in the context of this solicitation and what we are trying to accomplish on behalf

of the Nation.

The first bullet speaks to our first principle which says we will dedicate ourselves to the mastery and intellectual stewardship of the core competencies of aeronautics for the Nation in all flight regimes, and let me just take a moment to comment on this principle.

The word "mastery" means that what we do in NASA's aeronautics programs is cutting-edge research.

We conduct research in order to advance our knowledge and understanding in aeronautics, not to continue to do things we already know how to do.

Because we are pursuing mastery, we are, therefore, pursuing technical excellence and technical truth, and that in turn means that we adhere to the scientific method in the peer-review process. So that is very important.

The intellectual stewardship for the Nation implies that what we do must benefit the community broadly. So we don't target our research to benefit one or two particular special interests. What we do must benefit the community as a whole.

Taken together, our pursuit of mastery in our

intellectual stewardship for the Nation means that everything that we do, we will disseminate to the widest and broadest and most practical extent, consistent with national security and foreign policy, of course. So just keep in mind that everything that comes out of this study, we intend to disseminate broadly, and it is intended to be for the benefit of everybody's knowledge and understanding.

The second principle says we will focus our research in areas that are appropriate to our unique capabilities. So, very simply put, this means that we will not conduct research that is more appropriately conducted by other agencies, and we also will not conduct research that is more appropriately conducted in the private sector. So we don't do near-term incremental research in NASA's Aeronautics Research Program.

The third bullet is most directly related to why we are here today, which says that we will directly address the fundamental research needs of the NextGen, of course, in cooperation with our partners in the JPDO.

Now, hopefully, most of you here today are familiar with the terms "NextGen" and the JPDO, but if you are not, Bob Pearce will be talking a little bit more about

that in a few minutes

When I talk about this third principle, I like to emphasize the fact that some people, when they hear this, they think that we are talking only about our air traffic management research, and in fact, that is a very important part of our research portfolio and our contributions to NextGen, but it is not all that we do that is in support of NextGen. In fact, we also are trying very hard to address the safety challenges, the environmental challenges, and the vehicle performance challenges of that future system. So what we do in Aeronautics when we talk about fundamental research in support of NextGen, it covers a broad spectrum of challenges that are going to be critically important to enabling the NextGen vision.

These are our three research programs put together on one slide, and the program that is missing, I should just comment there is a fourth element of our portfolio called the Aeronautics Test Program, or ATP. That program is focused on ensuring that we sustain a critical set of Aeronautics test facilities in support of these research programs, but I want to focus on these three because these are what are directly addressing those

fundamental research needs of NextGen.

The Fundamental Aeronautics Program, which is run by Dr. Alonso who is up on this stage, in his program we conduct cutting-edge research to produce innovative concepts, tools and technologies to enable revolutionary changes for vehicles that fly in all speed regimes. So, in that program, you will see a lot of focus on noise and emissions and performance challenges, all very important things to overcome if we are going to talk about a future system that has much more capacity and flexibility than today's system.

When we talk about noise, emissions, and performance, we are not just talking about our interest in the traditional subsonic fixed-wing regime, but we are also talking about those challenges in rotorcraft as well as we look to supersonic aircraft as well. So, in that program, we cover all speed regimes from very low subsonic and rotorcraft all the way up through the hypersonic regime, and we worry about noise, emissions, and performance challenges across that spectrum as we try to think about how those particular vehicles will integrate into a future system.

In the Aviation Safety Program, which is run by Herb Schlickenmaier, there we are focusing on cutting-edge research to produce innovative concepts, tools and technologies to improve the intrinsic safety attributes of not only current aircraft, but of future aircraft. We think about the safety challenges, again, in the context of NextGen as we talk about having more automation, as we talk about introducing more complexity. We need to understand how does that impact how we think about the safety challenges of the vehicles that will fly within the system; as we talk about more advanced composites and other materials that we introduce into these aircraft, how does that impact how we address the durability and aging properties of those materials? So that program really focuses on looking proactively into the future and understanding the safety challenges not just of today's system, but rather, the system that we are trying to move toward.

The final program, you are going to hear more about. So I won't talk too much about it, but it is run by Dr. Toner. It is the Airspace Systems Program, and here is where we actually focus on our fundamental ATM research.

Here, we are trying, of course, to develop revolutionary concepts, capabilities, and technologies to enable significant increases in the capacity, efficiency, and flexibility of the national airspace system.

So what I have just outlined for you in just a few minutes, of course, is the majority of our research portfolio, and what this represents, I would argue, is a necessary, but not sufficient condition. I say that because I have outlined to you what is in each program, I have told you about the challenges that we are focusing on to address NextGen, and they are all critically important, the environment, the vehicle performance, which of course includes fuel efficiency and things like field length capabilities, the safety of those vehicles, and the airspace, improving its capacity and efficiency.

But you see the corner or the nexus, I should say, where they come together. That is where everything really has to be worked harder. We have to think about as a community, both within NASA and more broadly, how we integrate that research, so that as we are developing vehicle concepts, we are doing it with an understanding of how those vehicles must interplay with the airspace.

Conversely, as we are designing clever concepts and algorithms for making our airspace more effective andefficient, are we doing it in a way that doesn't negatively impact the vehicles that are going to fly within it.

So we really have to be thinking about this not just in terms of how we address each of these pieces, but how we integrate these pieces together, and that is really what today's topic is about and why we are putting the solicitation out because we need to think as a community how we are going to solve this very complex and integrated problem, but if we don't do that, if we work this in isolation, if we stovepipe the problem, then we are going to have people designing really cool supersonic aircraft that can't actually fly supersonically because the airspace hasn't been designed to accommodate them, or conversely, we are going to be designing a really cool airspace with really neat algorithms that forgot to take into account the constraints of the aircraft that are flying within it, and we don't want to be there. So we need to work this together.

This theme that I have just talked about, of

course, is not new, and I think many of you are familiar with this challenge and you understand it. It was, in fact, endorsed in the National Aeronautics R&D policy, and if you don't mind, I would like to ask everyone to raise their hands if you are familiar with this document.

[Show of hands.]

DR. PORTER: Okay, not bad.

This is actually an extremely important document. I think we have some copies of it outside for you if you don't have a copy, if you haven't seen it already.

This was actually the first time in the history of this country that the President has issued a policy regarding aeronautics R&D. So this is kind of a big deal, kind of a historic document, and part of the reason why it is so important, of course, is because it guides our research as a community, the entire Federal Government in aeronautics, and how we interface with the academic and industrial partnerships, and it guides it through 2020. So it is meant to be an enduring document, a longstanding document, and it has a goal and principles and objectives that are all very critical for the community to understand because it represents how we, the Federal Government, see

us going.

One of the key passages in that document is something that appears in the background section. So it sets the stage for the document, and I didn't cut-and-paste the entire paragraph. I would actually say the entire paragraph is worth reading. Actually, the whole document is worth reading, but I do want to emphasize this because I think it is really important.

It talks about how "as the science and application of aeronautics progressed, an interdependence developed among aircraft, the air transportation system, and the people who use these systems, resulting in a multi-dimensional, highly integrated aeronautics enterprise…", and "…Treating the entire system as a whole is complex,but necessary, and requires close coordination among multiple government departments and agencies, as well as industry, academia, and other non-Federal stakeholders to ensure that the needs of all enterprise users are addressed."

This really captures the essence of the problem right here because, whether we like it or not, we must treat the entire system as a whole. It is complex, but it is necessary.

So one of the things you are going to hear today is that we are really going to be looking for teaming because we strongly believe that there is no single entity out there that can solve this whole problem. It is going to require pulling together very smart people from a breadth of experiences, from vehicles, from safety, from the air transportation side, all working together to understand how we can better get our arms around this problem, and we have got to do it as a community, and no one entity can do it alone. So what you are really going to hear about today is a solicitation that hopefully takes some of those first steps and hopefully takes us in the right direction.

So let me close with a repeat of John's point, which is what our Aeronautics website address is. Please note that it doesn't say NASA.gov. It says Aeronautics.NASA.gov. It turns out, it is kind of hard to get to us if you go to the NASA website directly. So, if you write down only one thing, please write this down because once you go here, everything is easy. Some of you are laughing because you have experienced that.

Of course, you will find a lot about our programs. I didn't go in any detail because I didn't have

time. John didn't give me enough time. We have a lot of exciting stuff going on, and if you are interested not just not just in this particular solicitation, but other things that we are soliciting, we have a very active NRA process. Many of you have been taking advantage of that. We are constantly putting out new solicitations, and we are also keeping a list of who is getting awards and what the award titles are and where they are. The reason that is valuable to you is that it allows you to understand who out there is doing work that is relevant potentially for partnerships; if not here, then in other areas.

So we try to keep this very, very current, so that you guys can understand what we are up to, what we are funding, what we are looking to fund, et cetera, et cetera. If anyone doesn't have any questions, I guess we will move on because I probably used my time up. Are we okay?

DR. CAVOLOWSKY: You are fine. You have a little time.

DR. PORTER: If anyone has any questions?

DR. CAVOLOWSKY: If there are any media questions that you would like to ask -

DR. PORTER: I think they will probably want to

wait and hear the really good stuff which is coming in a little bit. Okay.

DR. CAVOLOWSKY: All right. Moving to the next part of the agenda, it will be Bob Pearce from the JPDO.

JPDO Perspective on NextGen

Research and Development Trades

MR. PEARCE: Good afternoon. I would like to say I am really pleased both to be here and for NASA inviting me to be here to reflect how what JPDO is going, what NextGen is about, and to help related to the studies that are going on, and I really want to applaud NASA for putting this NRA out. I think it is really going to help move the research forward as well as NextGen and specifically help move our plan forward.

One of the things I will get into a little bit is, from my perspective, a lot of this stuff is going to feed the NextGen plan. The plan is all of ours plan. It is not a JPDO plan. It is not a NASA plan. It is not an FAA plan. It is all of our plan for how we move from today to the future, to the Next Generation Air Transportation System. So, being able to tie these studies to that plan and to help bring that plan more to life with more detail,

more fidelity, is going to be great, and it comes at a very opportune time, which I will get into in just a moment.

I am going to quickly go through this. I know a lot of you have spent a lot of time with JPDO and helped us develop the NextGen plan. So I don't want to necessarily bore you, but I will just briefly touch on these and try to drive home a couple of key points.

The first thing is just to remind you that NextGen has a very broad scope, and as Lisa alluded to, it is not just about air traffic management. It is about the vehicle that operates in there. It is about the safety system. It is about the airport. It is about the information systems that bring it together. It is about security. It is about environment. It is about our international partnerships. It is all of that. So it is an exceedingly large and complex endeavor.

It includes, if you look across the top, all of the agencies that touch air transportation in one way or the other, from the Department of Defense to Homeland Security, Commerce through the Weather Service, obviously the Federal Aviation Administration and NASA being two very primary partners.

We also have an institute that brings the private sector on board, and I am going to talk a little more about that as well, but I want to just highlight the fact that it has a very, very broad scope. One of the things that this always reminds me of is that, there is a saying. I am not sure who first said it, but it has always stuck with me, that the first step on the path of failure is overestimating the difficulty of the task.

It is really hard to overestimate the difficulty of achieving NextGen, but it brings the point home that what we will do, though, is it will stop us in our tracks, it is too hard, we can't do it, it is too complex. Well, we have got to do it step by step, and the way to do it step by step is to have a plan and to undertake that plan.

The Basic Principles. I am sure if you have been around at all, you have seen this chart at least a number of times. So I am not going to go through all of these points.

I did want to bring out maybe two points. One is the first principle, user-focused. One of the things we want the system to do is we want it to be responsive to all of the users, not just the airlines, not just general

aviation, not just the DoD, but everybody who comes through the system ought to be able to use that system and use the capabilities of the aircraft that they bring to the system fully and get maximum benefit out of that. So getting a system that is that flexible and that robust is a very difficult thing, and it really requires us to think through what the users want to do in the future and how that is going to play out.

From a statistics perspective, I would point out that if you look since 2000 until today, we have not just seen growth, but we have seen just in those few years a lot of change. The airlines between 2000 to today have grown around 4 percent, not a thrilling growth rate. All of you are aware of the problems that the major airlines have had, but if you look at the low-cost carriers that have grown about 45 percent, look at the regional airlines that have grown about 150 percent, you are seeing growth, and we are seeing a lot of change in the way the system is coming back. Now we are seeing the advent of very small jets, very light jets, and on-demand air taxi operations, the desire for everybody and his brother to use unmanned aerial systems for one application or another. So while some

change is happening, we need to figure out how to accommodate that change.

Safety is another thing I would want to point out, too, because we spent a lot of focus on systems and how do we get better performance of what we want to accomplish here.

As all of you know, one of the things that we need to do is make sure every step of the way that this system is safe, and we have often done that by making sure that we make one small incremental change at a time. If you look at all of the change we are proposing to do in NextGen between now and 2025, it is really hard to see how you make one small incremental step at a time, but somehow we have got to figure it out, and we have to ensure the safety of the system at every step of the way. So that is going to be a very complex problem. It is one we need to address head on.

So, with that, these are the documents that we consider the NextGen plan, the Concept of Operations, the Enterprise Architecture, Define the Transform State of the System. The Integrated Work Plan is essentially the transitional plan between now and our transform state, and

then we also have a business case.

The reason I said this is a very opportune time for these studies to be coming out is because this has been a very big summer for us. We published the Concept of Operations. We published the Enterprise Architecture, and we just released the draft version of the Integrated Work Plan. It still has to undergo a lot of community vetting and so forth, but the first draft version is out there.

We essentially have, for the first time, the plan for NextGen. Now, is this a perfect plan? Is it a totally complete plan? Absolutely not, but it is a starting point. It is one that we can build on and improve, and we can start to implement. That is why these studies are so important because we really do need to fill in the holes. We need to fill in the gaps, figure out where we need more fidelity, understand the relationships between these systems better, understand the trades, and how things are going to play out, and these studies I think will play a really big role in helping us evolve this plan and helping us evolve the research and the implementations that follow.

The Concept of Operations, which I think is referred to quite a bit with respect to this particular

systems study, is not a users manual. It doesn't define exactly how the system is going to operate, but it does lay out what all the key issues are, what all the trades are, and it articulates the major concepts and how they fit together. If we are really going to turn it over time into a real concept of operations, there is a lot of work that needs to be done, and starting now, to delve into the very technical and important issues, it is really key for us.

I am not going to go through all of this. John and Lisa spent a lot of time focusing on their website. I am going to give you our website which is www.JPDO.gov. If you go there, you can get all of these documents. If you just go to the front site, you will see a Library button. Just go to Library, and you will get all of these documents. So they are there for you.

The Integrated Work Plan, as I said, is how do we step from today to that long-term future. It is organized by functional areas like trajectory-based operations or safety and so forth, and then it is broken down into specific operational improvements from here to that future state, and then those operational improvements are backed up by critical research and development, policy, capital

improvements, and key decision points, when do we need to make a decision about the role of the human or the ability to do self-separation and things like that. Those are laid out in there. So it just lays that plan out in actually quite a bit of detail.

It is a start. It is not perfect. I am sure there are lots of errors in it, but it is a place to start, and it is a place to develop improvements. That right now, as I said, is going to be going through a lot of vetting, and it will be updated. A significant update will take place this fall as we complete that vetting, and then it will be continuously improved from there on.

I want to just highlight within NextGen. As Lisa clearly articulated, NextGen is a key tenet of the NASA program, and from the JPDO perspective, NASA is an absolutely key participant. It provides staffing, funding, working group membership. They support a lot of the activities we do at the office. So, without NASA, we would be hard-pressed to actually even operate the JPDO, so a tremendous amount of kudos in terms of their support for the office itself, but more importantly, it is absolutely critical, probably the key organization that is going to

supply research for those longer term elements of NextGen.

We have a lot of stuff that has been in the pipeline for years. We were laying out what that implementation looks like over the next 5 to 10 years, but for the long term, when we really try to turn the more complex and full capability and put that into place, it is really going to depend on the research NASA is doing today and over the next several years for that to come to fruition. So the big role that we see NASA playing is in that research element, and without NASA, we are not going to get to NextGen, and again, these studies are critical in making sure that that research is going out to the right elements.

The last thing I just wanted to bring out -- and I am not going to brief all of this, but because of the nature of this solicitation, I did want to bring out that JPDO as a part of this is putting together a modeling and simulation capability in order to guide the planning effort.

Again, I am not going to brief this chart. I will show you the next chart which is the list, but I want to let you know that there is a lot of modeling and

simulation capabilities. I would encourage you to take advantage of what we have already done and to take advantage of the modeling and simulation capabilities that are there.

This is a list of analysis tools that we use right now and the folks that actually operate those tools, and again, in the spirit of teaming and partnership, I would encourage you to look at this and see how this might fit into whatever plans you want to put forward.

The last point I want to make is we are also through the JPDO going to be asking our institute, our NGATS -- we still call it the "NGATS Institute." We will call it the "NextGen Institute," but it is still the NGATS Institute for now.

We are going to ask our institute to start a series of trade studies that are tied directly to the NextGen plan, specifically to the key decision points within the Integrated Work Plan, to start to lay out the trade space and to start to lay out what those robust alternatives would be within the trade space and how do we start to get to making choices around those key decisions.

The key point to understand, because of the

nature of our job, we have to consider the full range of policy and economics, stakeholder issues, the technical issues and so forth as we do these trades. So I think these trade studies are going to be a very nice complement to the technically oriented system studies that this solicitation is focused on.

We are targeting, hopefully, in about a month or so for the institute to have this and to start to move that forward. So keep this on the radar screen as well because we would like these things to be complementary as we move forward.

That is it for me. So I will either take questions now or defer them for a little while.

DR. CAVOLOWSKY: Thank you, Bob.

We do have a few minutes in the schedule. So, if there are any questions that you would like to ask directly to Bob, we can handle those right now.

If I could ask, again, because we are trying to make sure we are capturing these for the purposes of this effort, if you could step to the mike, we would appreciate it.

PARTICIPANT: Do the other six agencies have

similar proposal opportunities coming up, and are you working with those as well?

MR. PEARCE: I guess the short answer is no. Each agency is taking its own sort of approach to how it is addressing its role in NextGen.

On the FAA side, there is actually quite a bit of activity, more on the development implementation side than on the research side, although there is a planned increase to the FAA's research budget. So I suspect that not immediately, but in the next year or two, there will be increases in activity in the FAA research arena as well.

DR. CAVOLOWSKY: If you wouldn't mind giving your name and affiliation.

PARTICIPANT: My name is Rick Packard, ARINC Engineering Services.

Does the JPDO have its own separate R&D budget, and if it does, are you doing stuff independent of what NASA is doing, or are they tied together?

MR. PEARCE: No. We do not have a separate R&D budget.

JPDO is not a performing organization, per se. We are actually a fairly small organization that has a lot

of affiliates, so to speak, but in terms of implementation of the plan, whether it is research or if it is development and implementation of systems, we depend on the agencies. So we are a clearinghouse. We put together the plan, and we work with the agencies in terms of how those plans get implemented, but we have a small budget. So we can do things like some of the top-level trade studies and other things that help drive that plan and help drive the direction of implementation, but we don't perform independent research.

PARTICIPANT: I guess I should have caveated that. I want to ask that question about the JPDO. I was including the NGATS Institute.

At the all-hands meeting about 2 weeks ago, there were some opportunities that Charlie Bergman had talked to coming up through the NGATS Institute.

MR. PEARCE: Right. It depends on what you want to call this. They are mostly analytical trade study kind of opportunities, but yes, we do fund studies through the institute to help inform the plan and help to drive implementation.

PARTICIPANT: All right. Thanks.

DR. CAVOLOWSKY: Any other questions?

[No response.]

DR. CAVOLOWSKY: Okay. Bob, thank you very much.

MR. PEARCE: Thank you.

DR. CAVOLOWSKY: As we continue to move through the agenda, let me now introduce Dr. Karlin Toner, director of the Airspace Systems Program, who will take a substantial amount of time now to introduce you to the objectives of the study.

Purpose of the Study

DR. TONER: Good afternoon. I got up this morning, and I told my husband, "I am so excited today. I am going to talk about something that we are excited to be unveiling, and I have got a whole group of talented people who have come to listen and really to help us formulate the question we ask in this SOW, so that we get it right, so that we are doing the right kinds of analyses to make sure we can integrate both the advanced concepts and vehicles into NextGen.

Lisa and Bob have told you a bit about NextGen. My job here really is to, in general, walk us through the proposed effort and then take questions on it, and I think

I need to try to see if I am successful with this. Obviously, the JPDO can do it.

There are three parts to this talk that I am going to give. I want to start out briefly with an Airspace Systems Program perspective. I am the director of the Airspace Systems Program, but let me assure you, this effort was brought to bear by all three programs. I know that Juan and Herb, who are here at the head table, I know that Vicki Crisp and Akbar Sultan are in the back. I know that there are others that I cannot see right now that are with us in R&D that have worked on this. It is important to us all.

I will do the necessary. I will walk you through a description of the study, try to very carefully, point by point, go through that, and then I will wrap up by re-summarizing the key points that we feel you need to know on the upcoming NRA.

Bob talked to you about the JPDO, about NextGen. From my program, our primary effort is being aligned with NextGen, looking at how do we provide two or three times capacity, but knowing that we have to do that while looking at safety, while looking at security, while looking at

efficiency, environmental capacity, the dimensions that aviation safety and fundamental aero can help bring to this effort.

We know that we have got to accommodate a range of vehicles, and this list is certainly not exhaustive. The list of vehicles is certainly not indicative of our highest priorities. It is to indicate from a user perspective, this system needs to accommodate a range.

Lisa talked to you a lot about the fact that NextGen solutions need to consider both the air transportation system, probably my number-one priority. You know, so what if the supersonic can't get in? Wrong answer. We have got to consider it together with the vehicles that want to operate in it.

In terms of Airspace Systems, we will be the program releasing this NRA. We have got two projects, the Airspace Project and the Airportal Project, airplanes flying gate to gate, but we needed to package the work in pieces.

The focus of the Airspace Project is in several areas. So, if we look at demand and capacity balancing, we would look at research focus areas such as dynamic airspace

configuration and traffic flow management, how do we manage capacity and demand and keep them equal.

If we want to keep aircraft separated, we would look at separation assurance and super density operations. We would be doing separation assurance under the even higher capacity operations than today, so really pushing it; trajectory predictions synthesis uncertainty, really an enabler in order to move to these kinds of operations, and then system-level design analysis and simulation tools. I am going to come back and talk on that one in a minute.

On the Airportal side, focusing on the surface, the arrival/departure, and even to the metroplex-type problem, so safe and efficient surface operations, coordinated arrival/departure management, and then transition and integration management which considers that metroplex problem and which has a close link to system-level design.

So, if I look at the bottom box, both projects conduct system-level design and analysis. A question that you might have is, "Gee, I am engaged with your projects. They are doing system-level design and analysis. What is different from this NRA?"

Often, the projects are interested in doing the design and doing the analyses to develop specific technologies. In this NRA, we are really going to be looking at the system implications of vehicles and ATM, how to work them together, but we are not going to be looking at particular technologies.

What I would like to point you to on the next two charts -- and they will be in the package of materials available to you, I believe -- the important thing here is the reference at the very bottom of the slide, once again, the Aeronautics website. If you have trouble getting to Bob's JPDO website, I believe you can get to it through the Aeronautics page. I think he was very clear.

Both of our projects, in fact, all 10 of the Aeronautics projects have the project plans posted on that website. So you can read the details of the work, of the goals we are trying to achieve.

That was Airspace, similarly for Airportal, and I think I have gone through the projects at a good enough level of detail.

Now I want to move on to why we are here. We are about to put out a NASA research announcement, and we need

the whole community to help ensure that we ask the right questions. That is really why we are here, and that is why we are really, really glad you are here today.

So what is our goal? The goal in going forward is we really want to take the user perspective that Bob pointed out for NextGen to help inform the research related to NextGen for NASA as well as the broader community. So we want to research specific issues associated with deploying new or advanced vehicles in NextGen. There are really three objectives that we have with this.

We want to understand how those vehicles might operate within NextGen. We want to understand the tradeoffs for both vehicles and the air traffic management system. As the third piece, as goes with many studies, we want to understand the most productive areas for future research, including further development of a modular analysis infrastructure.

So we have already talked about it, but we are going to look at the interactions, impacts, safety concerns, and tradeoffs among the air traffic system, among the characteristics of advanced vehicles, and the operation and performance of NextGen.

So, in our thinking thus far, we have laid out the approach in several steps, which may be done in parallel, but several stems in our thinking, starting by selecting and describing a set of advanced vehicles that might operate within the system we have defined as NextGen in the JPDO ConOps that will be implemented in 2025. That means the vehicle set that we will be flying in 2025. It might mean vehicles that we will be flying shortly thereafter, but will be using this air transportation system.

We have got to make some assumptions about how those vehicles are going to operate. So we have got to develop some procedures in order to simulate these. Importantly, identifying and addressing some of the safety issues associated with I have this system I call "NextGen," and I am creating a view of how I look at it, and I have these advanced vehicles. How do they interact, and what kinds of safety concerns am I going to have to worry about in that system of the future?

Lastly is conduct modeling analyses to determine the impact of the procedures of vehicles on the operation of NextGen and the tradeoffs that are involved there. We

seek optimum solutions for everybody, but we are going to have to come up with an optimal overall solution.

I have talked about procedures, aircraft, and safety. In the next three slides, I want to flesh those out just a little bit, starting with procedures.

We want to look at how advanced aircraft would operate and describe how they will operate and what constraints are imposed by NextGen requirements and concepts.

Like everything on these, these may not be an exhaustive list. I am looking for a detailed description of how each kind of vehicle might operate, what kind of flight trajectories, what kind of safety assurance, what kind of terminal operations, a whole range of questions on how that vehicle would operate in the new system.

Procedures necessarily must flow from the ConOps as well as attributes of the vehicles and the performance that is desired by the users. When we look at the procedures, we all know we can't count on the weather to be lovely every day for us. We need to look at a broad range of weather, traffic density and other conditions, and how those procedures might vary, if they do.

In terms of advanced vehicles, on the left-hand side is a list, certainly not an exhaustive list, of what vehicles could be considered, what is coming in the future, perhaps more commercial space launches, how does that work with our system, perhaps different utilization of rotorcraft, perhaps supersonic transports are operating in our NextGen system that is implemented in 2025.

We all hear about UAS's, very light jets, very large transports. These are all realities, and how will these guys work with our conventional fleet? So we can't just do the simulations and look at how our conventional fleet is operating. Really, how can we start including these as the users would prefer?

On the right is a list of vehicle attributes that could be considered, whether it is runway requirements, departure and approach constraints. Environmental impacts is very important. It may be driving our system performance more and more in the future. Clearly, the vehicle operational envelope and sensitivity to weather effects is important.

Safety is probably the area where we have struggled perhaps the hardest in laying out what we want in

this NRA, and it is because safety is really important and it needs to be a pillar of this NRA, but now I am saying I am taking new vehicles. I am taking a new system. I am trying to fly them. I guess in Karlin's fantasy world, I am going to fly these and see how they interact, but I really need to, I would say as a first cut, understand what are the safety implications of these new configurations of operation. Ultimately, from a NASA perspective, I want to get down to what are the most important aircraft technologies for safety that I can invest in, but I am going to have to work to understand that.

So the study needs to include a safety assessment. It needs to address potential safety issues, albeit assume vehicles and procedures, identifying potential risk, looking at potential severity, looking at possibly mitigation strategies and their effectiveness, definitely looking at potential impacts and tradeoffs versus performance, but really making this a strong three-pillared study that includes vehicles, air transportation, and safety.

I want to make clear that the intent of this study is to gain insight into potential procedures and

their tradeoffs. It is not our intent to down-select a particular strategy or procedure out of this study.

When we look at analysis of the assumed procedures, we will focus on many tradeoffs. They might include efficient operation of the NextGen, effective use of the advanced vehicles, modifications needed for the vehicles to safely and efficiently operate in the NextGen system.

The analysis should necessarily be informed by modern results where otherwise quantified. This isn't fully a subject-matter expert study. There really needs to be some analysis done, and the analysis should be framed so that it can be conducted -- though we may not have considered every vehicle, but we want our analysis framework to be able to consider other vehicles in the future.

Looking at the time frame, we have talked about analysis. We are probably going to have to use or adapt existing models or analyses. Bob mentioned several that are in use by the JPDO. They may need to be extended for this study in cases, and that can be done as part of this study. It is also important that the analysis structure is

compatible with the metrics that are already being used by the JPDO and by NASA. They may reflect a greater level of detail.

When we look at studies, why is NASA doing this study, why isn't the JPDO doing this study, I think there are some differences. We talked about the JPDO's role in looking at operational and economic as well as technical considerations, whereas we are focusing on technical considerations.

The JPDO is also asking the question in their benefits assessment of what should we invest in. What NASA's NRA needs to do is ask how should we do it.

We had sent a draft synopsis of this NRA out to technical experts from across the three programs, and I gave them 2 days to read it. I held a telecon, and about 2 hours later, I said, "Oh, no, they don't get it," but the first question they asked me, "Are you looking for a systems analysis, or are you looking for research in this study? Because we think we can do the systems analysis, and the research is hard." I said, "I am looking for the research." So I really am looking for how do we start making these things work.

I listed three particular models that as we put the solicitation out, we would definitely put references to. These are three models that are NASA-developed models that would definitely be made available for the study, the Earth-Based Concept Evaluation System, the Air Traffic Operations System, and the Future Airspace Concept Evaluation Tool. Once again, it is not a comprehensive list. It is three that I point to that will be available.

I mentioned earlier that as we step through this study, we define vehicles, we define procedures, we analyze them. I think it is going to be important in particular studies that we identify the issues for follow-on research. We will definitely consider, should this study be successful, having follow-on opportunities.

So what would we want to know at the end? Topics for which further knowledge needs to be developed, limitations of this study that resulted from lack of good enough tools, recommendation for further model development, what are the strategic areas where we need to develop that, what should the modular infrastructure to really make these kind of trade questions answerable look like.

That in a nutshell is a view of what we are

looking for in this NRA. I wanted to point to some particular considerations.

We really do want broad viewpoints. So what does that mean? We think this study is broad enough. It involves all of our three programs, and we think we need aspects that are not just from the air traffic management domain, but from the advanced vehicle domain, from the safety methodology domain, from the systems analysis and modeling domain. There are probably some I have excluded, but we think this requires a broad team.

We certainly want to try and capture some best candidate concept and ideas. We may not capture all, but let's try and look at some promising ones, and again, understanding of issues. This isn't a technology down-select.

As we form this study, some of the tasks that will be required include workshops. We intend to inform the NASA research programs about what some of our investments should be, but we really want to engage the community, so our results will be used to complement the JPDO's work and our results hopefully help other ways in the community as well.

So tasks will include reviews of the study approach and results, perhaps workshops to afford opportunity with interactions with other stakeholders, providing the opportunity for coordination with parallel studies such as the JPDO studies because those studies will provide data that can help guide us.

I talked a little bit about building on prior and ongoing research, including the models that are already existing, and the coordination with JPDO.

That is a brief look at the study in a nutshell. I am going to wrap up, highlighting some of the key points, some of the things that we feel are really important for this.

I told you I think and I am going to tell you again, the focus is on interactions among the operating procedures, the characteristics of the advanced vehicles and the ConOps, and safety is a key part of that.

We are now down-selecting specific procedures. We are looking at impacts and tradeoffs.

Safety is a key ingredient. How we address it is something we feel we need to get to.

The study schedule forces us into using and

adopting some existing models. I don't think this is a full model development.

Engaging the community is going to be an integral part of the effort, sharing the knowledge that we learn. Teaming is really, really strongly encouraged if we are going to get that diverse set of viewpoints.

Three desired outcomes that I will point to, improving the understanding of operations under NextGen, we really look at the ConOps, and it is a perfect opportunity. The JPDO has just stood up and aircraft working group, understanding that we need to focus on the aircraft with a system.

Gaining knowledge to help inform NASA's research as well as being useful to the broader community, and finally, a path to a modular analysis infrastructure for NextGen.

This is probably one of my simplest charts, one with the least words, but probably one that you are looking for. What do we expect in terms of key NRA information? We expect that the maximum budget for this is $6 million. We are looking for one study with the maximum duration of 18 months. We are working the solicitation. We have been

working hard on it. We expect the release probably very early in September.

The key deliverables for that study would include things like an interim report on approach and early results. We will be looking clearly for how a team can be effectively ramped up to perform such a broad research engagement in just 18 months.

The final report, contractor report, absolutely, but we are looking also for some publishable final results. This is a research effort, and we would really like to see publishable outcomes.

Finally, I will point to workshops to review and share the study results. This is not the exhaustive list of deliverables, but I think these are some of the key deliverables we will be looking for.

John pointed out earlier that right now we are able to have a dialogue. We are able to gain some inputs. We are able to address questions, but really, as we move forward, the way to get information, get your questions in, is to go through the point of contact. The only way to do that is via e-mail. So the e-mail address for inquiries is shown on this screen, and I am sure John will reiterate

that with you.

I hoped that I would have now the big blue screen, but this is okay. I don't like the slide with the question mark. So I pulled it out. I think we are now moving to Q&A.

Question and Answer Session

DR. CAVOLOWSKY: Indeed, we are. We have actually stepped rather smartly through the agenda. We are a little bit ahead of schedule, allowing more opportunity for questions. So this is your chance.

Step up to the mike. As I mentioned earlier, I need to recommend and insist that we get these questions in writing, so that we can capture them well and give back proper responses and comprehensive answers.

Again, as we step forward, if you would provide name and affiliation.

PARTICIPANT: Mike Ball, University of Maryland.

To what degree in the research plan would it be appropriate to look at what controls and what incentives should be in place to induce the users to behave in a way that best uses the system?

Your presentation in some sense sounded a little

reactive, how are the users going to use the system, et cetera, but to what degree might we take a viewpoint of how does this system proactively induce users to behave in a way that really maximizes the potential of the system?

DR. TONER: That is not the primary focus. However, we have to make some assumptions on how these vehicles are going to operate, and so I think that that could be a driver in how we generate those assumptions.

PARTICIPANT: Okay. Just one clarification point. You said one study. So there is one award to the solicitation?

DR. TONER: I said one award is what we are looking at.

PARTICIPANT: Okay. Thanks.

PARTICIPANT: Hi. This is P.K. Menon from Optimal Synthesis.

On your list of vehicles, the resilient aircraft are included, you know, airplanes that might be? That is not a category.

DR. PORTER: Which aircraft?

PARTICIPANT: The resilient aircraft.

DR. PORTER: I think we would look at any class

of aircraft that we believe will be operating in the NextGen system.

PARTICIPANT: Okay. Thank you.

DR. CAVOLOWSKY: Let me remind you, we do have a full table of very capable responders to questions; from the fundamental aero side, Dr. Alonso, and from the aviation safety side, Herb Schlickenmaier. So please feel free to address a breadth of questions.

PARTICIPANT: Will this be on the web to review?

DR. CAVOLOWSKY: We will make it available through the website to access requests for the information. It will be available through Aeronautics.NASA.gov.

Yes, please.

PARTICIPANT: Ed Stevens from Raytheon.

A couple very simple questions. How long of a time do you think you are going to give for a response?

DR. CAVOLOWSKY: I will be covering some of those specifics in my last wrap-up slide before we close the afternoon down, but we are planning roughly 45 days from the release, approximately.

PARTICIPANT: There also seemed to be some implication that there might be an organizational conflict

of interest in this job where you said you were going to start defining future work. That would be a concern to a number of people, I think, just a statement, I guess.

DR. CAVOLOWSKY: Can you clarify that?

PARTICIPANT: You don't want us writing specifications for follow-on type of work that would preclude whoever won the first contract to go do other follow-on work. That would be a concern.

DR. CAVOLOWSKY: I appreciate that as being a concern.

DR. TONER: I guess I could comment on that. I don't see a conflict of interest because whoever gets selected, whatever team gets selected, the results will be disseminated broadly. So everybody will have equal access.

I don't want people not to propose because they think they cannot benefit from the results further on.

PARTICIPANT: Kevin Jordan from San Jose State.

I simply would ask if you plan on this NRA to be a cooperative agreement or a contract.

DR. PORTER: I would anticipate a contract.

PARTICIPANT: Okay. Thank you.

DR. PORTER: I would say, though, that the

vehicle will depend upon the selection. We wouldn't say it is absolutely going to be a contract, so most likely.

PARTICIPANT: I just ask because it affects the nature of the interaction between the team and NASA.

DR. PORTER: In what way?

PARTICIPANT: Well, I tend to think as a cooperative agreement involving substantial Federal participation as opposed to a contract where the deliverables are specified more in advance.

DR. PORTER: Regardless of how it is structured, I think you are going to have a lot of participation from NASA, as Karlin indicated, with workshops and the like, the interim reports and that kind of thing. So I would say that the interaction should be similar. A contract, you are right, does allow you to be more specific in terms of deliverables, but still, with a cooperative agreement, we will ensure that there are the same kinds of interactive mechanisms as there would be for a contract.

PARTICIPANT: Great. That is what I was hoping for was the interaction. Thank you.

DR. PORTER: Okay. Sure.

You guys should take this opportunity to ask

questions now because you are here, but also, I did like the question that came in about how to induce users to behave in a way to optimize the system because that gets us thinking. So some of what you want to do is say, "Hey, we think you have missed something here, or you may want to consider this question as part of the solicitation." So, to clarity a point that John made or to emphasize it, we are not just looking for questions on what we are thinking. We are also interested in your views. Given everything Karlin told you, are there things that you think that we should make sure we also ask for in the solicitation, given the overall goals and objectives that she outlined? So we are interested in your perspectives, and we do want to get those.

PARTICIPANT: I am Ella Atkins, University of Michigan.

Along those lines, could you clarify the role of this study with respect to DoD airspace access, and then also, kind of nontraditional users such as the kid in the back yard wanting to get a look with their camera at a high altitude?

DR. PORTER: I'm sorry. That is just a cute

image.

I think, Karlin, I would defer to you on how much you want to focus on a DoD perspective. I would say certainly that we are looking at a -- go ahead. I am going to let you comment on that.

DR. TONER: Okay. I certainly can't comment on the DoD's effort. We are focusing primarily on civil applications. DoD is necessarily a player there because their aircraft operate in our airspace, but that is not the driver for us.

But for the little kid in the back yard element, clearly, I think we are trying to understand the roles and trades as we look at the flexibility of the system that we are trying to accommodate. I should say the span of the vehicles that we are trying to accommodate.

You were giving an example to make a point, I assume?

PARTICIPANT: Yes. I think the broad question is where does the minor player fit in. You have not talked much about general aviation, experimental aircraft, that type of thing in your slide, but even going to the more minor player than that is the kid in the back yard. In a

trade study that speaks of statistics, those kind of users can get lost.

DR. TONER: That is a really good point. I would say certainly -- and this is part of the beauty of an NRA -- if we tell you we are interested in understanding the trades, as you look at broader expansive vehicles, part of the beauty of an NRA is that you can propose back the level to which you think that looks like in 2025, and therefore, the system considerations one has to accommodate.

We will think about that because that is good input, whether or not we want to be that prescriptive in the solicitation, but I think that is really good input.

DR. CAVOLOWSKY: If I could maybe turn the question around a little bit. When I heard it, I wasn't as much struck by the position of the user and access to the system for the non-conventional user, but from the perspective of understanding the new operational risks, the safety concerns that we will have as we implement the system in 2025, will there be any unique impacts that the unusual user will place on what we would consider to be the more conventional operations. Those are things that clearly need to be included in this study to make sure that

unintended consequences of that class of user of the system aren't providing significant safety risks or impacts or other concerns that need to be part of this. So that is a very important point that I think we need to take into consideration.

DR. PORTER: Very well said, John.

PARTICIPANT: Vikram Manikonda, Intelligent Automation.

You mentioned workshops as one of your deliverables for the study. Do you anticipate the workshops to be something like workshops or conferences organized by AAAI and others where you open the workshop to all communities, or is it more focused towards the contractors who are involved in that and the relationship with the Government? Because organizing workshops to explain ideas would be quite different from what you typically do under a consideration.

DR. TONER: I would say that that is an excellent question and one that we haven't fully thought through.

Clearly, we would want to engage with the Government and with JPDO, particularly in interim workshops or workshops -- I have not thought through at all, until

receiving this question, would we be asking for an IEEE session or something like that.

PARTICIPANT: Okay.

DR. TONER: So thank you.

PARTICIPANT: Terry Thompson, Metron Aviation.

I have two questions. The short one I think is will FFRDCs be eligible to bid on this.

DR. TONER: No.

PARTICIPANT: The second question is broader. In the same vein as designing the system and potentially considering different types of user behavior, there is going to likely be a see-change over the period of NGATS, the time frame of NGATS, and the environmental impacts or the desires of society to control those impacts.

So could you just comment on what you see as the scope of environmental investigations within this study?

DR. ALONSO: I think we all understand that the environmental constraints are going to be very important in the future. So we are looking certainly as the impact of noise and emissions, both in the terminal area and in the end-run system. So we are hoping that the majority of the conclusions that get drawn from this study are based on

existing tools rather than on focusing on developing the next generation of tools for noise and emissions predictions.

DR. CAVOLOWSKY: Please let me remind the speakers that we really do want to have these in writing, so we can make sure that we are answering them properly and comprehensively. So, please, even those of you who have not, I would like you to submit them before we leave today. Thanks.

PARTICIPANT: Victor Cheng, Optimal Synthesis.

The aeronautics, typically, you have been dealing with a lot of [inaudible] aircraft, but you didn't mention launch, space launch vehicles. Space launch vehicles in terms of safety requirements is totally different. You are talking about the expected casualty of 3 to the minus 6, as opposed to -- 3 times 10 to minus 6 as opposed to 10 to minus 9 for aircraft.

So the study needs to deal with not only the launch and return. You also deal with potential debris. In 2025, you are also dealing with potentially space tourism, so, again, new launch vehicles, new launch concepts, and different launch sites. So do you intend to

cover all these potentially different areas in the trade study?

DR. TONER: Okay, Victor. We absolutely expect that space launches, there will be more of them, and there are a variety of impacts from those. So we would be interested.

I have got to caution us in looking at particular vehicle or vehicle safety of spacecraft would not be our intent from this study, but how those launches interplay with other vehicles operating in the system is probably a question we need to address.

PARTICIPANT: Michael Schlabach. I am a consultant at DARPA.

A quick question. It is a little fuzzy to me about what the actual goal of this research is in that we talk about procedures for different types of vehicles being used. Which one is driving which? In other words, are we stating that NextGen is driving the procedures and the requirements for the vehicles, or are we stating that here is what the vehicles are capable of doing, and here is what the rules should be? Which one is actually the cart, and which one is the horse?

DR. TONER: Okay. The snippy answer is it depends whether you talk to me or whether you talk to Juan.

[Laughter.]

DR. TONER: So Juan wants the last word. Okay.

There is a trade that needs to be made. Coming from the Airspace Systems Program and working with JPDO and looking at NextGen, we have said all along that the NextGen system will have a user focus.

I think it would be my opinion that we have been a little weak in making sure that we have that user focus. So, from a NASA perspective and a NASA portfolio perspective, we have wanted for NASA to make sure that we are considering these aircraft. So we are trying to bring them in.

Who is driving who, that is a tough question.

PARTICIPANT: Part of my motivation for that, with my experience, my specialty is unmanned systems and also dealing with a special community, two or three down in RTCA.

One of the things we found, just trying to integrated unmanned system in the national airspace, is that what was desired, depending on who the user was, there

was a lot of resistance, frankly, from some of the commercial aircraft to unmanned systems because, let's be honest, there is a potential there to start replacing pilots in certain cases.

So what they wanted and what the unmanned systems wanted were completely different. Obviously, you are more specialized in rotorcraft and so on. So that is why part of my motivation for asking that is just who do we talk to. Are we supposed to talk to the individual users of each of these platforms? I guess, again, who is driving whom is really where my question was going with that.

I will sit back down now.

DR. TONER: That is the whole goal of today is to have some of the hard discussions and focuses. The question that I outlined for us, for this NRA, is actually very broad. I don't think for 18 months and $6 million, any of us can fully address all the answers we want to all the questions I laid out.

Nevertheless, I think it is our responsibility to start looking at particular scenarios of here is what a future world might look like, do we break NextGen, do we break it for safety, do we break it for environment. If we

break it, do we have to back off on the vehicles we are thinking of.

I have told Juan you can't build that aircraft for my system just because it has a cool wing. That doesn't work, and he can tell me the same thing with just another example.

So we have really just got to start testing the system, and this is a first step.

DR. ALONSO: I would like to expand on that one. I think while the analogy of the horse and the carriage is a good one, it is perhaps not the right one for this study because it is essentially the interplay between those two communities that you are discussing about that we are after in this study.

That is, from my point of view, I certainly don't want artificial constraints to be imposed on future vehicles that we may be interested in, sort of contributing to realize, simply because we haven't thought about it, frankly, and vice versa, if Karlin actually puts together an air transportation system concept without the information that comes from the potential of vehicles that will fly in it, she will likely miss something. So the

idea is to play at that interplay area between the two and not have one driving the other.

Just one more thing, we will have a number of concepts or ideas of types of vehicles that may actually operate in this aerospace system, and we will be asking or trying to get answers to the questions of how to best offer it to the system.

MR. SCHLICKENMAIER: Safety always aces both system and vehicle. It is a controls paradigm.

As we start to take a look, as Juan pointed out and as Karlin has pointed out, at the variety and diversity of vehicles that are potentially operable in the NextGen, especially in 2025, are we going to be hampered, for instance? I don't know what an S-76 is going to look like in 2025, but in instrument flight rules, whatever that means under NextGen, an S-76 will be flying a three-degree glideslope trying to slow down for a 757 in front of it. What are the diversity of vehicles? What is the safety that embraces those diversity of vehicles? That is why it is not horse and cart. Actually, this is team of horses pulling, and the three of these have to balance as we start to look at the vehicles. Otherwise, we are going to have

NEXtNAS, and I am not sure that is everything that we are standing up for. If NEXtNAS is it, then we hopefully will have done the analysis that proves that point, but I am an optimist, and I think the diversity of vehicles, UAS and whoever the student is, University of Michigan, 500, taking a picture above, general aviation to me is not a minority today. It may be in NEXtNAS. I hope it is not.

So where is that question? Why is it now? Because safety is a constraint based on 40 to 50 years of how we have done it incredibly safely in a system. There is a hard walk to step off of as we are walking into NEXtNAS, and we have got to do this heads up.

Questions?

PARTICIPANT: Again, this is Vikram from Intelligent Automation.

I have one more question. You mentioned the user modeling and simulation as a tool to perform a lot of these investigations. Given that several of the existing tools do not model the NextGen vehicles, they may model concepts of 2025, NGATS and things like that, can you comment on what do you think the emphasis is on actually doing the study, developing the tools, and do you view the

development of tools and new tools as deliverables under this contract?

DR. TONER: There will definitely be some tool development. I would guess under this activity, as you say, the advanced vehicles aren't represented in the current modeling systems to a degree that might be necessary to do these simulations. However, the modeling is not the primary focus.

DR. ALONSO: I was trying to understand your question. Are you referring to the modeling of the actual performance and operating envelope of certain vehicles, or are you talking much more broadly about development of other tools?

PARTICIPANT: [Inaudible.]

DR. ALONSO: I think I understand your question. We have had this discussion internally, and what we intend to do is make available tools. In fact, I wouldn't call them tools, but sort of small software packages that actually tell you or inform you about the performance of certain classes of vehicles that we have existing.

We have some under development which are not likely to be available during the proposal period, but

likely to be available once the proposal is actually awarded.

In the cases in which we cannot provide you with a tool in this definition, we will inform you with the performance characteristics of the vehicles that we intend to have in there.

DR. TONER: So Juan is commenting on vehicle performance models or descriptions. Actually, embedding those into an airspace tool could take effort.

PARTICIPANT: With all these great philosophical questions, I really hate to ask the mundane question, but I am anyway.

After the period of performance came for the proposals when we turn them in, in 45 days, when do you expect to make the award, and do you anticipate it being a cost-plus or a firm-fixed or some other kind of contractual arrangement?

By the way, I am Ed Yarbrough with Honeywell.

DR. CAVOLOWSKY: Let me address at least part of that.

As we wrap up, I have a slide that will lay out some of the timeline. As mentioned, 45-day proposal

development period, submit it at the end of that. There will be roughly an equivalent length of time whereby we will go through our review and selection process and then engaging in the negotiation before final award. The final expectation is the January-February time frame to award.

The additional question in terms of the type of contract, TBD.

PARTICIPANT: Pete Kostiuk from LMI.

Can you expand a little bit on your vision for this future modular integrated analysis environment and how important it is to this particular study? Because as you mentioned, there was going to be a number of existing models, some other tools, or little software packages. Obviously, if you are going to do trade studies across a very broad technology range, you are going to have to integrate these tools in some way, but I also noticed that your deliverables do not say anything about delivering models or an integrated analysis environment, but there is a little teaser in there that seemed to indicate that you are looking for a plan or maybe a proof of concept as part of this study.

DR. TONER: I think in the time given and the

scope given on the analysis, definitely in our draft SOW, we do have tools as a deliverable, but, no, it didn't make the charts today.

I think we have got to look at this as a first step, and partly, this analysis framework, it may be an approach to getting at the problem and a demonstration with what we can put together in that time frame of how that framework would work. So I would think of it as a framework. I would think that there is some tool development component or adaptation of tools, but I think of it as a framework of getting to the three-pronged question we are asking.

DR. ALONSO: I think we all want to emphasis the first steps portion of this whole thing. I think Karlin just said that.

We are also emphasizing that Karlin said before, and that is that we would like this study to inform future developments. Future developments may be new tools that actually are required to capture the types of things that we cannot capture today, and the modular infrastructure is in there and one of the three bullets that you did put out because we clearly anticipate that in the future that we

are going to have a solution for answering these questions, which is not use all of the modules we have now, but it will use some other ones that we would like not to continue, so not to start from scratch, but rather to continue for something that started with the study.

PARTICIPANT: Terry Thompson from Metron Aviation.

There are a number of other NRA programs already underway. Simply put, how will this project coordinate or not coordinate with those programs through the first 18 months?

DR. TONER: First of all, this particular NRA is being released from Headquarters, and it is being released from a program and program portfolio perspective.

There are a number of NRAs that are ongoing within each of our programs, projects, and some, for example, I believe that Fundamental Aeronautics has one related to noise and emissions. There are some in my program that will be related.

We see this particular study having its own purpose. However, it won't [inaudible] the coordination with the others. However, just like with the JPDO trade

studies, as the phasing is correct, we would definitely like to see that in our action.

DR. ALONSO: I had hoped that some of the workshops that were mentioned before would involve some exchange of information between some of these ongoing efforts and the new one, the one that we are discussing here today. There is not an effort that is parallel to this one within NASA right now in the scope of all the different programs, but there are lots of components that could help.

DR. PORTER: Okay. So we have told you everything you need to know. Right?

Let me make a broad observation. As part of an NRA process, we don't want to be overly prescriptive in terms of making some of those trades, which are judgments, in fact, in terms of how much you want to focus on developing new capabilities within a model, so that you can answer questions versus how much you want to focus on running existing models to try to understand the trades. You will only have so much time, et cetera.

So, when you write your proposals, different teams may come at it from different directions, and that is

why we are not giving you very prescriptive answers because, in fact, we are looking to you to come in and propose, well, given the time, given what is available, given the state of knowledge today, and given our team, this is how we propose to address these research challenges, and, of course, keeping in mind that this is a first step. Hopefully, what we get out of this study, as Karlin mentioned, is a path forward, what are the things that we need to be doing perhaps differently as a community within NASA, but even more broadly, what are the questions that emerge out of this study that we say, "Oh, by looking at these trades, we have actually discovered something we haven't been putting enough of our attention on."

So, again, we are not looking for a complete solution. I think everybody understands that, but we are also looking for you to come in with your proposal of how you would address this, and there are some hard questions and hard trades. You are going to have to decide how you want to tackle it. So that is why we are not being too prescriptive because we really want your thoughts on how you want to address that. Hopefully, that is clear. So this isn't an RFP. This is an NRA.

Any other questions? Go for it. Excellent.

PARTICIPANT: Ella Atkins, University of Michigan.

I want to ask a question about safety. We have pretty clear notions of vehicle model, of air traffic management from the slides earlier, but beyond separation assurance, I didn't really see a definition of what is being pulled in through the safety side. Things such as IRAC within the Aviation Safety Branch seems like they would be a natural candidate to put in here, also what is happening all the ground under just airspace over urban areas and so forth.

DR. PORTER: Herb?

MR. SCHLICKENMAIER: Absolutely. You have hit the nail on the head. We have had decades of understanding how to do safety of the system and predicated on separation assurance and conformance to flight plan, et cetera, operating under assurance flight rules.

There is a challenge in front of us that I am not quite sure we have given the intellectual investment, if I can put it that way, to what constitutes safety in the next generation system.

If we actually look at aircraft-to-aircraft separation, I don't know what constitutes safe, and I don't know what constitutes operational air.

So one of two things happen. One, we slip back into old habits that have been very, very comfortable for 50 years because it has served us exceedingly well, or we actually pull together the best and brightest minds in the Nation under this NRA and pose that fundamental question.

When I sit down and I take a look at what is going on with the Resilient Aircraft Control Project in the recent NRA announcement that Joe Totah and the team put out, there are some really exciting topics. I hope everybody here has taken a look at them. They are wonderful.

I will tell you one of the things that is actually applicable, and it is not just the Resilient Aircraft Control that is taking a look at adaptive control theory. If you take a look at the technical plan proposal that we put on the website in the Aviation Safety section, I would really commend everybody to it. There is an approach to adaptive control that we are trying to break forward, and it is breaking the bonds of the modern control

theory that we have been living and successfully conducting our controls work under for the past 40, 50, or 60 years.

As we start to pose questions about adaptation, so not just resilient control, not just recovery from upset, but adaptive systems, our real theory is pretty thin. We can do the wonderful discussion about space launch and look at 10 to the minus 6, and we can look at 10 to the minus 9. I have no idea what those really mean in a true safety construct as we move to a NextGen system.

So what are those new issues that we need to have our arms wrapped around? Those are the things we are begging for, if I can be that pedestrian, with this study. They are open because we don't have the answers to them. We have got some concepts.

We know that separated aircraft is good. I don't know how to balance, however, the performance of the vehicle against safety. I don't know what the inducement with the benefit factor is to induce vehicles to perform better to the system yet because I don't know what that safety assurance needs to be. It is a fundamental question that needs to be addressed in this study, and while we have packages for some of the performance side, the vehicle

side, and the systems side, we don't have the equivalent level. I don't have the methodology labs to hand you in a library, so that you can go off and do the trade studies.

PARTICIPANT: Since we are talking about adaptive control, what is the position of this study with respect to cooperative control? There is certainly this duality between taking someone's -- a pilot's hand off the stick, so that it can cooperate in an interloop kind of way with other aircraft versus not doing that.

MR. SCHLICKENMAIER: Oh, I guess they are looking at me again.

Again, it goes to the ConOps, and it goes to what the level of safety assurance is. While all good controls engineers can sit down and do a compartmentalization and do a hierarchical decomposition of what the risk factors are and all of you good ones can do that well in your sleep -- Right, Ed? -- at some point, we are still applying modern control theory, and we are looking at bracketing, very innovative techniques to try and introduce some semblance of autonomy to the problem. However, it is still based fundamentally on that control theory that we are quite comfortable with.

Accordingly, the V&V of those methodologies live deep in the heart of a process that was innovated back in the '70s for flight systems performance to do trade studies, given a constant level of performance, and quite frankly, besides not having the control theory fully in place, a lot of the approaches to V&V for adaptive systems are still under question.

There are a variety of ways to look at adaptation. One of them, of course, is a non-hybrid kind of parameter identification and then do an update based on what the plan looks like. The other is looking kind of innovatively at directs and hybrid systems where you are starting to introduce neural [inaudible] and things like that, and that is much more adaptive learning.

I am not quite sure that that approach has the basis, but again, the community that I am expecting, I don't think we would preclude an approach that takes a look at what that performance benefit would be to the system. How you validate it is going to be extraordinarily tough. So I would look forward to that piece of the study we have described as well.

DR. TONER: I think we have to be careful within

the scope of the study that we don't want to look at particular technologies, so whether the pilot's hand should be on the stick or not, to be overly simplistic. We need to look at the broader picture of really how we do the design of the system with the vehicles in mind and consider the safety aspects.

PARTICIPANT: My emphasis in that last question was on cooperative control, not adaptive control, and I do think that has a very fundamental bearing on this program, even if you don't call out a specific technology.

MR. SCHLICKENMAIER: Correct.

PARTICIPANT: Because the notion there is that you decrease separation distances substantially by having neighboring aircraft to share their stated position.

MR. SCHLICKENMAIER: Correct.

DR. CAVOLOWSKY: So that functional allocation of responsibility between the ground and the flight deck needs to be essential consideration in any of the trades and any concepts of advanced vehicles and operations that are put forward in this.

Similarly, the functional allocation between human and automation is also wrapped up in that same

concern that you are addressing.

So, yes, critical things to evaluate, and again, they don't have to be done from the perspective of unique technologies, but rather from the general approach to addressing the capacity problem from our perspective.

PARTICIPANT: This is P.K. Menon again from Optimal Synthesis.

So the ConOps that you were talking about is the JPDO ConOps. That is one we will be working with in the study. Correct?

DR. TONER: Yes.

PARTICIPANT: Thank you.

PARTICIPANT: One more question. How important in your study is the economic benefits to the stakeholders? Do you want any trades done on that at all?

DR. TONER: It is not called out as a primary focus, and we are not intending this to be purely a cost benefit study.

We really want to -- why don't I let Lisa tell you the correct answer.

[Laughter.]

MR. SCHLICKENMAIER: Although the three of us

could probably say it at once.

DR. PORTER: Yes. We are trying to focus on the trades that Karlin has outlined and not look at the economic impacts which are a part of the broader JPDO considerations. Basically, we have put enough on the plate as it is.

DR. TONER: I think there is a realism we have to have. The entry question on how do we set up these, there is a realism we have to have, but it is not the focus.

DR. PORTER: Any other questions? Any other things you want to recommend that we make sure we think about? We have gotten some good suggestions. So, if we don't have an answer, that is good because that tells us we have got to go back and flesh something out.

DR. CAVOLOWSKY: As we look at the agenda for the rest of our afternoon, we are in a few minutes probably going to take a break. How you could use that break to discuss some of what you have heard, I am hoping that that discussion may generate some additional questions. We will come back after break, and we have some selected presentations that we will go through.

Again, the intent is to help provide some more

opportunity for discussion, engagement on issues that we think may be important to the study. We will follow that up with another Q&A period we have set aside.

As Karlin and Lisa and all have pointed out, we are trying to make sure that we get this right, and by talking to you, presenting our intentions right now, soliciting those questions and the concerns is how we are going to get it right. So, again, coming back to that second Q&A, I hope some other things will come to mind which you will be willing to ask and share with the group, but at this point, we have taken enough.

We are a little bit ahead of schedule, but not that much. How about around 3 o'clock? That is roughly 15 minutes for the break that we have scheduled. Please reconvene, and we will have some presentations.

Thank you.

[Break.]

Participant Briefings

DR. CAVOLOWSKY: What we want to do at this point in time is move to a different element of this interchange, and it is part of the next section for selected briefs.

This is all part of, again, our promotion of the

teaming in terms of the way we are looking to take advantage of this opportunity with the NRA and to get the best out of the community.

I want to make clear that the primary purpose of this is to inform potential partners. The presentations you will hear from the group of you who had requested presentations earlier in this registration process, I want to make sure they have a chance to talk to you all about capabilities that they can bring to a potential partnership, but also, as Lisa was pointing out before we broke, the opportunity to discuss any issues, food for thought of discussion, things that may be important as the partnership and the team is put together to respond to this solicitation.

I will make it clear, these are not invited presentations. They were chosen from those that were sent in from the registrants before the posted deadline. They were selected, again, to fit the available time, but also in representation of the breadth of topics that are important and relevant to this NRA, not the entire breadth. This isn't everything that we need to consider, but it certainly is representative.

So, again, with that little preamble, this is to let you know why these people are going to be stepping up and what they have to offer. Let me move to the actual briefs themselves. We have nine individuals from organizations that will be talking today.

In an effort to be fair, we have 5 minutes for everyone. So we will be stepping through very quickly on this, but they will tell you more about what they do and how they do it and what they bring to this potential partnership.

So, Dan, if you would, please.

Purdue University,

School of Aeronautics and Astronautics

MR. DeLAURENTIS: I guess I get a few seconds extra free here. So I want to, first of all, thank NASA for the opportunity to have some of us speak. We certainly appreciate it. So I will just also give you forewarning, of course, as a professor, I can't say anything about anything in 5 minutes, let alone the topic that I have been working on and we have been pursuing at Purdue that I think is relevant here, an that is sort of an intellectual foundation for System of Systems. So, with that, I am

going to give it my shot.

I thought I would use one of my precious five slides just to also introduce myself, Dan DeLaurentis. Also here at the meeting from Purdue, we have Professor Tom Farris who is the department head or school head of our School of Aeronautics and Astronautics and Dr. Steve Landry who is a professor in industrial engineering working in airspace research as well.

That is our pretty campus, which, of course, looks that way in the summertime.

Again, fearing that I would go over time, as you sort of take a look at this, let me summarize what I hope to say, and that is I think the challenge already that is going to be described in this NRA has already been articulated, but we have sort of put some words here to that.

One of the things that comes to my mind is something that Richard Bellman, the famous sort of thing that he said, which is the right problem is always harder than a good solution.

What I am hoping to convey to you is that we have been doing some, of course, research at Purdue in

fundamental aeronautics and airspace and air portal, but what I am going to give you a few inklings of today is a System of Systems approach that we think will help define the right problems to be pursued in this kind of context that we have talked about today. It is just a conjecture.

Related to that, probably you have read the daunting challenge that I think we all share. If you look at the second bullet, one of the claims that we want to emphasize or we are making is that the science to ensure this greater capacity in safety and understanding how to achieve those objectives has really not been developed yet. So this effort is going to require more than just connections of tools to evaluate technologies that may be in the horizon, but really how do we understand this thing called NextGen which is a collection of independently operating heterogeneous systems that have policy and technology and operational considerations as all part of their dynamics. So it is certainly a challenge.

We have been doing some efforts that, again, briefly I will just be able to talk about. Without that new analysis, systems analysis capability, we probably won't be able to ask the right questions, let alone even

coming up with some of the solution trajectories.

Again, the second point then, if that is the problem and challenge we have, in the short amount of time, I can't go into all this approach, but really the System of Systems concept, we have been trying to move beyond buzz words and actually develop a way to describe different types of these problems that involve interactions of heterogeneous systems that have their independent purpose, but also should work together in some environments or operational context for the greater purpose of the whole system. So this is the challenge of analyzing and understanding these interactions which are both dynamic, directional, uncertain, time-varying, all those challenges that go along, and we list the things that you know, of course, are constituents in the system from airplanes to airports, et cetera.

We have some related research going on with NASA. So we just pointed out some of that, and I do want to highlight that there was a pilot study on the System of Systems approach that we were able to conduct about a year and a half or 2 years ago that really was extremely important, and very grateful at Purdue for that opportunity

to sort of pilot this approach using some quantitative methods to capture this kind of very complex problem.

I am sure I am getting close to my time. I haven't seen the 1-minute mark circle yet, but I am getting close.

I just wanted to give you a flavor. Of course, I can't talk about some of the actual tools and techniques we are developing here, but this is kind of the good news and the bad news chart. The good news is we have started to think about describing all of these components and the categories of resources, operations, economics, and policies that are relevant. The bad news, it should strike you as a very complex set of layered networks, which is actually what this is, and also, the dynamics in each of those four columns have to be understood if we are actually going to try to get at some of these emergent behaviors that we think may develop in the NextGen system. So that is really the point I want to make here is the scope has to include those four categories, and the layered network modeling I think is very crucial.

As I wind down, I have one more detailed chart of some stuff we have already been working on. This is an

example. It is a little picture actually that helps you more than the words. It is actually looking, for example, at an airport and how it actually persists in several different networks, and the dynamics in those networks have to be analyzed over time in all those categories, including, ultimately, multi-model and ground transport issues.

Thank you very much.

DR. CAVOLOWSKY: Thank you.

[Applause.]

DR. CAVOLOWSKY: Next, we will hear from Pauline Froemberg from Raytheon.

Raytheon, Airspace Management and

Homeland Security Business Area

MS. FROEMBERG: Good afternoon. I will wait for my first slide, I guess. I will just tell you that I work on a program as a program manager on Advanced Programs in Raytheon's Airspace and Homeland Security Business Area.

I started this slide just to show you some of the programs, some of the programs in Raytheon's portfolio that relate to transportation, and it covers the radars and the airplanes and the airports, and you can't really see the

highway system, but it is up there in the left in a kind of grayed-out fashion. We cover all of those in our portfolio.

Raytheon has worked with both the JPDO and NASA on several programs. On the JPDO, we were an early participant and an active participant in the architecture design and in the IPTs. With NASA, we have worked on several of their programs. In fact, Raytheon has invested in some of NASA's programs. We have done it. We know what we need to do, and we would like to continue doing that.

This starts out with Raytheon is taking the "A" out of NGATS. It is not because we don't think the airports are important. The airports and the airspace is very important, but it is not the whole of NGATS or the whole of the transportation system. Raytheon is looking at it as a system of all the transportation systems that take into effect, with an emphasis on the airspace and the aviation, but with everything that is there. We look at all transportation as the solution in our system.

We feel that you need an integrated system. You need all the stakeholders. You need everybody there, and the solution needs everybody to participate. Then you need

NextGen as the center with all the various pieces fitting in.

The most difficult and the most critical is the future concepts, those that we don't know. Raytheon has integrated a number of systems, a number of systems with many components, but with unknown components, that is critical. So we need to know what those are going to be, so we can then specify how those are all going to fit into the system.

My final slide is your success, NASA, JPDO, and all of the Government agencies is our mission. We understand the critical issues and challenges that we are going to face. We have several core competencies, but it is not a Raytheon. We have worked with a number of you already. We have involved you in our teams, and we involve all our team members in collaboration. So, as part of our team, you will be doing a lot of interesting work. We look forward to working with you. We can make this vision a reality together. We must work it as a team, taking in the Government, the academia, all the businesses and industry, and all our stakeholders.

I look forward to meeting with you and working

with you. So please come and talk to me today as a way of building a team.

Thank you.

[Applause.]

DR. CAVOLOWSKY: Thank you, Pauline.

We will follow on next with Demoz Gebre from University of Minnesota. My apologies, I am afraid I have butchered that.

University of Minnesota,

Department of Aerospace Engineering and Mechanics

MR. GEBRE-EGZIABHER: Thanks for giving me the opportunity to talk here this afternoon. I am Demoz Gebre, and I am here with two of my colleagues, my department head, Gary Balas, and Yiyuan Zhao. We are keenly aware that 18 months is a short time span for a university's work. So what I want to do today is show you some of the things that we have done, some of the capabilities that we have that we think will fit into being able to contribute to working on this project and the time scales that are involved.

A little bit about us, the University of Minnesota, we are located in the Twin Cities. Our

department is within what is known as the Institute of Technology which, unlike other schools -- I guess it would be analogous to a college of engineering, but we have the hard sciences, math, chemistry, and those things also in the Institute of Technology.

Within that department, Aerospace Engineering, we are broken up into three groups: Aerospace Systems, Fluid Mechanics, and Solid Mechanics. What I am going to talk about today mostly is what the Aerospace Systems group does, and faculty members, about 300 undergrads, and 85 graduate students.

Some of the research that we have done and are doing right now, here is a sample of them, high-integrity aircraft navigation. Basically, what that involves is -- it is mostly my work there -- where we were looking at the next generation of navigation systems, GPS-based systems, and how do you design, look at the integrity, the safety aspect of them, so worked on things like WAAS, the Wide Area Augmentation System, and what you see here is some of the work we did for the Navy and for the Air Force having to do with the joint precision, approach, and landing systems, the next generation navigation and guidance system

that the military is looking to develop for aircraft operations.

Other stuff we worked on, there is some work on micro aerial vehicle control, looking at advanced ways of controlling them and operating them. Airborne networks, again, Yiyuan Zhao is here, he does work on that, and then advanced concepts and ways of looking at how you integrated unmanned aerial systems into the airspace, and in this case, we are looking at using these vehicles for inspection infrastructure, highway infrastructure and things like that, and what does it take to integrate them into the national airspace, what kind of technologies and what kind of things you have to think about.

So we do have, again, background experience in working on problems that are relevant to this project. Again, I am just listing them here as bullets, fault tolerant design, sensor integration navigation, high-integrity sensor fusion, and then the big part there, optimization of System of Systems, and that is the type of work that, again, Yiyuan Zhao, who is here today, does, and again, I think it is very relevant to what we are talking about here today.

We have had, again, just as an indicator that, again, we have worked on this, and we continue to work on this. We have had several projects, including stuff that has been funded by Government agencies, but we also have very close ties and we have worked very well with a lot of industrial partners. I am just listing two of them that have a pretty big and strong presence in the Twin Cities area that we work with closely, Honeywell and Lockheed Martin.

That is really all I have. Thank you very much for listening.

[Applause.]

DR. CAVOLOWSKY: Thank you.

Natasha Neogi from the University of Illinois will follow.

University of Illinois

MS. NEOGI: Hi. I am Natasha Neogi. My title slide looks a lot more bare than everyone else. Simply, I am representing a center-scale effort, which is a collaborative initiative between the Massachusetts Institute of Technology and the University of Illinois at Urbana-Champaign, along with several other industrial and

governmental partners dealing with developing a multi-scale, multi-objective engineered systems approach to looking at things like the next generation air transportation system, and I am going to just show a little bit of our capabilities in terms of the safety, security, and reliability portion of the work and the model techniques we are developing.

Of course, very controversially, we raised the idea of what does it mean to be safe and secure in terms of a next generation air transportation system, and so everyone has kind of seen this slide. One of the big things to keep in mind is all of these properties, safety and security, at least for sure are emergent properties as we know. So, thus, if we are giving a system or if we are giving a component in which we consider to be safe or secure -- and I am not even sure what metric you would use to define it -- composing it with another safe or secure system or even with an environment you have not characterized -- by environmental, I mean humans, operational procedures or operational concepts, or even new technologies which we don't have any historical data on -- it may not give you the results that you would probably

expect. So it is with a great deal of trepidation that you wish to apply old techniques or techniques perhaps that were used in the 1960's to validate or verify the national airspace system at the time in order to come up with these new metrics or declarations of safety, security, reliability for these new systems.

We all know that the reasons why we are looking forward is to deal with capacity, and of course, this is a problem with not only national, but international significance.

So current practices that we are looking at today have this caveat of being centralized, and of course, the air transportation system is extremely voice communication-based. These will probably change when we are ready to deal with capacity and conformance concerns. However, in the framework of safety, security, and reliability, often safety and security are competing in terms of whether or not you generate a protocol for the interaction of components which is extremely secure, but then this impedes your performance or does not allow you to come to safety guarantees.

What we are looking at or interested in

developing or have some experience in developing are frameworks which help to quantify tradeoffs between these two qualities. When I say quantify, I mean in a very broad sense. We cannot assign numbers like 10 to the minus 6 or 10 to the minus 9. We just look at one set of operational concepts and say, well, this is more safely or less safe than another set of concepts.

So this is in the context of these future trends which essentially deal with this partially distributed and collaborative environment that is going to encompass this next generation system, which will allow for heterogeneous or mixed equipage aircraft or vehicles to interact. So defining interfaces between components will help you be able to quantify any sorts of qualities you wish to assure, and something to keep in mind is there is a very incestuous relationship between cost and the rest of the qualities we want to assure, like environmental impact, reliability, et cetera.

We have got a pretty good movie here which essentially lets us talk about what are the verification and validation approaches we want to use. So, if you have an aircraft which is allowed to do adaptive altitude

management, perhaps to avoid weather effects, we all know weather effects account for about 60 percent of delays in today's system, how do we make sure the architecture in which this aircraft can live allows it to behave in a safe, secure environment and yet increase capacity. So we have to come up with different ways of having these vehicles interact and then perturbing them incrementally and seeing whether or not there are hazards or attacks or possible holes or levels of uncertainty that we have not quantified or identified yet. In that way, we can gain some idea of the adaptiveness or the resilience of the system with the operational procedures we are engineering for these extremely advanced vehicles and operational concepts to interact.

We also have to keep in mind we are dealing with human-centered automation. We cannot design and then hope for the user to learn. These are user-centric systems we are hoping to build, and as well, they are agile systems, which means they are extremely adaptive as well as being extremely reconfigurable. Obviously, we want to make sure the environmental impacts are minimized.

So, finally, to finish up from some preliminary

analysis that we have been looking at or doing, some of the issues we have seen raised in the building of these complicated systems that are different for air traffic control involve the fact that while security is everything, of course, but other people, of course, will disagree. However, if you take my point of view, there are a few extreme concerns, such as denial of service is not allowed, and of course, highly complex interactions cause accidents. So we have to be very careful when quantifying safety and security in next generation air transportation systems.

Thank you.

[Applause.]

DR. CAVOLOWSKY: Thank you, Natasha.

Kevin Jordan from San Jose State University is up next.

San Jose State University

MR. JORDAN: Thank you.

San Jose State University has a longstanding collaboration in aerospace human factors research with the NASA Ames Research Center that involves university faculty, senior research staff, and graduate students in our Human Factors and Ergonomics Programs and Experimental Psychology

Program.

Our longstanding collaboration and our history of conducting far-term research on advanced concepts such as the Free Flight Initiative of the 1990's has prepared us to look out to 2025, we believe. It also allows us to address more near-term requirements of NextGen for emerging in spacing operations and continuous descent arrivals, the goal, of course, being to increase capacity while increasing safety and security and decreasing the environmental impact of air transportation.

We believe that some of our recent accomplishments point to our capabilities to conduct research and analysis in air transportation management concepts, and I list some of them here. I would like to step through them.

The first three are more research-based, and the final bullet is really a point of pride that we are here and participated in the JPDO-sponsored NextGen down on Capitol Hill for both the House and Senate.

First, Dr. Thomas Prevot of our staff has developed a Multi-Aircraft Control System. This is a JAVA-based program that emulates and simulates current and

future air traffic operations in the national airspace. It is a comprehensive environment for both large- and small-scale, real-time integrated air-ground simulations that allows for a rapid prototyping environment, and it also serves as a test bed for future ATM concepts and inclusion of a wide range of vehicles.

At the recent USA/Europe ATM R&D Conference in Barcelona, San Jose State staff had two presentations. My faculty colleague, Dr. Kevin Corker, along with Paul Lee and Tom Prevot of our staff presented their multi-sector planner research where they compared the multiple DSIDE [ph] controller with traditional controller teams, and we provided a sample result there that the multisector planner configuration produced reduced vectoring, brought it to the baseline configuration in the weather scenarios. This paper, I will brag for Dr. Corker, was named Best Paper of the Seminar.

Dr. Thomas Prevot of our staff also presented a paper at the conference in Barcelona in conjunction with several of his San Jose State colleagues and their NASA colleagues, E. Palmer and Nancy Smith, where they examined the [inaudible] concept involving arrival and emerging

spacing information during continuous descent approaches into a high-density environment. They looked at different levels of ground automation with or without airborne spacing, and as a sample result down in the lower right-hand corner, you see the airborne spacing reduced the mean and the variance of arrival spacing at the runway significantly, which, of course, has the potential to increase capacity.

The final research program I also want to present is work headed up by Vern Baptiste in San Jose State along with several San Jose State colleagues and Dr. Walt Johnson of NASA Ames that was presented at the 12th International ACI Conference in Beijing last month. The CSDS they have developed provides voltaic conflict detection and resolution capability. It can display aircraft state for the intent information. As you can see on the left-hand side, it has a manipulable 3D viewing angle, including the traditional top-down view, and it has a variety of other abilities such as integrating weather and terrain information and provides emerging and spacing tool.

A couple of sample results where the pilots using this display were able to meet their meter-fixed

restrictions while maintaining separation, and the pilots who participated in the work assigned particularly high ratings to the display range and path predictors.

To close, San Jose State University has been a long-term partner with NASA, conducting world-class research on advanced concepts in air transportation management. We have capabilities in systems engineering, computational modeling, human factors and cognitive science. Our recent accomplishments, we believe, demonstrate that we are capable of contributing to both near- and far-term NextGen milestones, and we hope to do just that.

Thank you very much.

[Applause.]

DR. CAVOLOWSKY: Next up from the FAA, Maryalice Locke is going to talk to us about the collaborative efforts from the teaming associated with the environmental working group.

FAA, Office of Environment and Energy

MS. LOCKE: As John mentioned, I am from the FAA, which makes me a little bit different from the rest of the panel because I am really representing the Government here

as opposed to a direct teaming partner.

I am from the Office of Environment and Energy, and my office also chairs the environmental working group of the JPDO. From that standpoint, we are here to help you all ensure that environmental protection is addressed in NextGen development.

Motivation behind our work on the environmental tools program is that, historically, the tools really focused on just a limited area. These are obviously complex interdependencies, but our historic tools just focused on noise or emissions and local air quality emissions. By focusing just on one subject area, you are really creating unintended consequences elsewhere.

So we recognized this, and we focused our efforts for the last several years, 5 years, on developing a tools suite that works interdependently. I must apologize in shortening this to five slides. I realized that the fourth bullet doesn't make a lot of sense, but from the fourth bullet up, we are talking about history. So the tool processes do not support recommended practices means the old tools don't support the recommended practices to look at things interdependently and to look at the economics.

That last bullet is really talking about the desired characteristics of our future tools suite which are currently developing. While they are built on existing capabilities, so we are building from the historical tools, we are building them to work together independently. We are very focused on having the tools suite internationally accepted. Our program is not meant to be exclusive, including all stakeholders, and not competitive. Our work is transparent. That is one of the key points that we have that we are not working with black-box systems, and we want our tools to represent a variety of viewpoints.

Another point that we wanted to make, because I am speaking for the FAA, I wanted to let all of you know that there are partners out there. We have a lot of participants in the development team, and these are just some of the logos of the various groups that are participating.

A key element of our effort is the Partnership for Air Transportation Noise and Emissions Reduction, and that is a consortium of universities. You will be hearing from one of them a little bit later. That would be Georgia Tech, but we have many universities involved in this, and

some of the key players are MIT, Georgia Tech, and the Volpe Transportation Systems Center.

This is a diagram of our tools suite effort, and for those who have seen different versions, it is slightly varied. It is supposed to be popping something else up, but it doesn't seem to be doing that at the moment. Basically, we refer to three main tools within the tools suite, the environmental design space which you will be hearing about in a few moments from our speaker from Georgia Tech, the aviation environmental design tool, which really addresses what the noise and emissions characteristics are, and the aviation environmental portfolio management tool. AEDT is the element where the lead group on that is the Volpe Transportation Systems Center, and the APMT element is primarily led by MIT, but there are many other people working on that effort. The APMT element addresses the economics both from partial equilibrium block, but also from impacts.

Then finally -- there is that button that popped up -- I wanted to just remind everybody that environment is a key constraint on the capacity to grow aviation's future, and FAA has made a commitment to use these tools. They

simply provide a framework for analysis.

So thank you very much.

[Applause.]

DR. CAVOLOWSKY: Thank you, Maryalice.

Steve Waslander from Stanford University will provide you a few comments now.

Stanford University,

Department of Aeronautics and Astronautics

MR. WASLANDER: Hi there. My name is Steve Waslander. I am a postdoc at Stanford University, and I am currently working under Professor Claire Tomlin. I have been with her for the last 5 years, and yes, it is official. She is moving to Berkeley. We are losing her from Stanford University.

So, just briefly, I am going to go over the work that we have been doing in the systems lab over the last while, and it falls into four main categories, many of which are very applicable to the concepts we are talking about today.

The first is optimization of air traffic flow. Here, we are looking at both the entire mass level as well as the sector and center-type control problems, trying to

manage air traffic control decision-making to manage the capacity restrictions in the airspace subject to weather disruptions and unknown disturbances.

The second area, real-time strategies for aircraft conflict resolutions, this looks very much at the individual aircraft and how we guarantee that safety can be ensured when there are conflicts on the horizon.

The next initiative control, critical aviation systems, this looks at sort of a hybrid systems modeling approach to cockpit displays and these sort of situations where you want to know what this set of possibilities are and whether or not those outcomes are actually safe and to avoid any situations that are undesirable.

Then finally, UAV design and tests, where we are developing various UAVs in order to be able to see how to operate those in the air traffic control system.

So I will go into three of these in a bit more detail. First off is air traffic flow control, which is the focus of a lot of my work. So here, we are looking at abstracting the airspace in such a way that we can still make useful decisions without running into the issue of computational complexity as the problem is varying very

quickly and is on a scale that is really hard to solve in real time.

The work that I have been looking at in this regard is to try to bring into the optimization process, the user perspective. So here, I was looking specifically at the airlines and how we get them involved in the optimization process for air traffic flow control, but this concept wants to be extended to all of these new types of users that we are discussing today. So this would be an area of excellent development for future work.

So the work here was involved in incorporating the specific costs of the individual airlines and looking at the theoretic considerations that might result if you have these individual users working in the system together, fighting over resources and that sort of thing, and how you manage those to ensure that you get the proper outcome.

The second area is the collision avoidance using regional sets. So this is the conflict resolution, and we have been working here for the concept of trying to guarantee safety in some sense. So we are using the notion of regional set where the evader knows exactly what the possible control inputs are, the boundary control inputs of

some pursuer, and we literally treat it as a game where one aircraft is attacking the other. So it is doing the worst possible at all points in time.

So we can define from this a set of states from which it is actually possible for that pursuer to enter the conflict region of the evader. So we know if we define those states as unsafe and know that for any of the states outside that region, there remains a control decision that can be taken by the evader that will guarantee safety, and so this can be seen as sort of a last-resort type of control situation.

This algorithm has been implemented already on the Dragonfly UAVs, which [inaudible] and were able to avoid collision with one of the UAVs blundering in the path of the other, and it was also demonstrated on an F-15 and a T-33 using [inaudible] Boeing [inaudible] demonstration where the T-33 was running [inaudible] off the same software on the laptop, literally sitting in the cockpit and manage to again avoid the errant maneuver by the F-15.

Finally, I would like to describe our most recent test bed, and this is a multi-vehicle test bed where we are now looking at focusing on interactions with more than just

two vehicles. So we have these, the Starmac Quad, we call them, and they are now flying autonomously. We have built six of them. It is our second design iteration. They weigh less than 2.6 kilos, but have enough computational capacity on board to fly fully autonomously and to plan in real time for collision avoidance, and that is exactly what is going on this summer. So we are hoping to have four more of these vehicles flying autonomously working together to avoid collisions, and in the worst case, avoiding each other if they have to without interaction.

So thank you very much.

[Applause.]

DR. CAVOLOWSKY: Thank you, Steven.

Next, Fred Wieland from Sensis Corp.

Sensis Corporation

MR. WIELAND: So, John, I have been dying to ask this question all day. Who is this young lady who keeps showing up here?

DR. CAVOLOWSKY: My daughter would be mortified if she knew that her desktop has been broadcast here.

[Laughter.]

MR. WIELAND: I was wondering if she had the

inside track on me as --

DR. CAVOLOWSKY: No. It is just my girl.

MR. WIELAND: My name is Fred Wieland. I am representing Sensis Corporation. I want to thank the NASA leadership here for allowing us to speak. Greg Carr is also here from Sensis out in California. Greg is in the back left there.

So Sensis Corporation basically has a variety of different analysis and modeling tools that we use to analyze mass. One of them is called ACES. It has been talked about earlier today. Sensis Corporation is the primary technology integrator for ACES. That means we have on our staff, people capable of configuring ACES, running ACES, changing the internal algorithms of ACES in case something needs to be changed for the future of the mass, but it is a NASA-owned model. It is a model that is owned by NASA.

The rest of these models that are up here are basically Sensis proprietary models. Av Demand allows us to generate future flight schedules and flight plans, and that includes future flight schedules for different types of aircraft, for different aviation business models, like

point to point or hub and spoke or SATS-type business models.

Av Terminal, which allows us to model in detail the terminal area, this is an area that ACES doesn't model too well in detail. So we filled it in with that terminal, and Av Analyst is a tool that allows us to analyze the output of ACES. So we have a bunch of tools and a bunch of analysts that basically can use and run this ACES product.

Now, let me talk about ACES really quick. ACES is a physics-based model of the national airspace system. That means it is not a queuing model. It is a physics-based model. It has a full degree of freedom flight trajectory model in it. We have run it successfully with over 100,000 flights, 2X and 3X type of mass, and it has embedded in it, both flow control algorithms and air traffic control algorithms that replicate pretty faithfully the way the system operates today. We can reconfigure these to represent a future configuration of the system as well.

Internally, it is structured as an agent-based simulation. It has got thousands of agents or hundreds of thousands of agents because each flight is an agent, and we

model the flight from gate to gate basically. So we are modeling the whole path of the flight.

Now, this is one of the projects that we have been doing in advanced vehicles. This is for NASA Ames. We are looking at extremely short takeoff and landing vehicles. This is a vehicle that can take off and land on the runway. It is only 2,000 feet long, carries 120 passengers, flies cruise and Mach.8 and has a range of about 2,000 nautical miles.

Such an aircraft can use Runway 11 at Newark. This is Newark Airport here. So this runway is virtually unused today by the major carriers. So we basically used out Av Demand and other tools to model the terminal airspace. The arrival and departure routes change with such a vehicle type, as well as the [inaudible], the trajectory in and out of the airport, and the trajectory parameters of such an aircraft also change. So we have used our models to model all the different parameters of such an aircraft to look at its impact at Newark and also using ACES to look at its impact system-wide. So we have some experience in these new terminal types.

This is an excerpt from a presentation that I

gave in Barcelona, Spain, about a month ago at the ATM conference in which we used basically ACES. I work under contract at the JPDO. We used ACES to analyze the performance of NextGen. So we are actually able to configure ACES to look at what we call the Segment 3, which is an intermediate state, and Segment 7, which is the final state of NextGen, and we looked at that not only in good weather, which is what most analysts do in benefit analysis, but also in several configurations of bad weather. In the bad weather, we looked at bad weather, convective weather, not just at airports, but also in the enroute airspace. In the enroute airspace, we did a relatively novel technique. We basically used time-varying sector capacities in the end route airspace to model the movement of fronts through the airspace. In order to do that, we had to change the internal algorithms of ACES. NASA has asked us for that change. So we are wrapping it up and packaging it up and giving it to NASA.

So that is all really I have to say. To summarize, we are the primary technical integrators of ACES. So we have a lot of experience using that model. We have used it to look at new vehicle types, and we are fully

integrated in the JPDO NextGen Performance Analysis Environment at JPDO.

Thank you.

[Applause.]

DR. CAVOLOWSKY: Thank you, Fred.

Wrapping up our list of speakers this afternoon, Michelle Kirby from Georgia Tech.

Georgia Institute of Technology,

School of Aerospace Engineering

MS. KIRBY: What is better, going first or last in the day? Wake up, more coffee.

I am Michelle Kirby. I am a research engineer at Georgia Tech. I work with Professor Demetris Mavris, who could not be here today. Dr. Peter Hollingsworth is also with me.

I wanted to show to you today a few of the capabilities that we have internal to our lab. Our lab is the Aerospace Systems Design Lab. We have been around for about 15 years now. We have got 30 research staff on full time. We have got 150 to 175 graduate students on a yearly basis and about 50 undergrads usually that we bring in to filter through. So we are a pretty large organization. We

kind of call ourselves the "Rapid Deployment Force." So, when I saw 18 months, I got very excited.

The hierarchy of our research at our lab is really kind of tiered towards the system at NASA. We work collaboratively with a number of industry partners. This is one we have matured different processes and methods that we developed usually from our Ph.D. students on the very basic level. Typical funding is coming from Air Force or NASA, FAA, and Office of Naval Research. We transition that methods through a different proof of concepts, and once we [inaudible] it enough, then it is prime time, ready to handle for industry partners.

The number of research areas that we are involved with is extremely diverse. You have got a large organization. You need to be diverse as various funding waves come in and out.

We have really focused a lot of effort on developing and advancing techniques and start doing risk analysis. We are looking at design space exploration for both vehicle concepts, torpedoes, ships, whatever, you name it. System of Systems, both from a commercial and a military aspect, robust design in terms of looking at how

your system can respond to various uncertainties, and really, probably one of our key efforts was being able to looking at infusing technologies, technology assessments, looking at vehicle concepts and vehicle designs.

As Maryalice mentioned, we are also the key developer for the environmental design space, which is just one of the tools of the FAA tools suite. The work there really built off of all the technology work and technology assessments that we had done for NASA over the past 7, 8 years. We took all the NASA tools that had been developed at its different centers, and we have linked them together and enhanced them in a capability such that we can do various technology concepts, advanced concepts.

We have been going through a rigorous process with international community on the acceptance of EDS within the policy-making decision-making. We are getting a lot of good feedback on enhancements and feedback capability for the NASA tools sets, but it is a mature environment that we are using to address different types of technologies and concepts of the future.

One specific effort that we are working that actually Dr. Alonso alluded to earlier was an analysis of

the fundamental aero technologies and how that affects different concepts and propagates into the airspace.

We have teamed up with Sensis, and Sensis just described all the tools that we are using of theirs. We are also working with the Air Transportation Laboratory at the Georgia Tech Research Institute, MIT, Boeing, and IOTA [ph]. Effectively, what we are looking at here is what are technologies on the vehicle and the different types of advanced concepts in terms of supersonic platforms, very light jets, and the like, and how is that going to affect performance, environmental impact in and around the community and also on a global scale.

We are hoping this will end up on a 2-year study. It is leveraging a lot of work that we have already done over many years and bringing in the appropriate people.

In hearing what I have heard today, I think this could be a good starting point as a jump forward for the study.

So, with that, thank you.

[Applause.]

DR. CAVOLOWSKY: One final round of applause for all of our speakers. Thank you very much.

[Applause.]

Next Steps

DR. CAVOLOWSKY: Apparently, I was a bit more intimidating than I thought when I gave them the riot acts of five slides and five minutes. We finished a little bit earlier than I had thought, but thank you again for the fairness to holding to the restrictions that I had placed upon you.

What I want to do at this point, we are about to head to our final Q&A, and I am hoping there are some more things in some of the presentations, over the discussions in the hall and break, but I would like to go to actually the next steps. Some of the questions that we were addressing earlier in the process actually hit upon the last slide that I want to put up. So, before we get into Q&A, let me put this up. I will talk that one last slide, and then we will open the floor.

As mentioned, the way that we manage the solicitations is through the NSPIRES process. We give you as much information as we can on the way to access and to register there through our NASA website, again, which you have seen multiple times now, but I need to encourage you

early in this process just to register. You will get all the information you want in terms of the specifics of this NRA and as a way to stay on top of things and a way to be able to respond to our proposal.

In NSPIRES, you will find that the ROA NRA 2007, again, which stands for Research Opportunities in Aeronautics and the NASA Research Announcement, is going to be referenced by this particular number, and what you are going to find is that this topic will shortly be an amendment in our NRA 2007. It will be captured in the appendix.

Frankly, right now, you can get in and read. We have material which explains and puts all of our NRAs in context, as well as seeing other NRAs, other opportunities that you may not have otherwise have been aware of. So, please, we encourage you to register and go to our NRA.

The schedule, I outlined this briefly, but let me point it out now in black and white. The release of the NRA is pending in the next several weeks. Sometimes we hear it takes long for you, NASA, to get these NRAs out, but frankly, we want to make sure we get it right. The whole purpose of this conference is to make sure we get

this right.

So, as Karlin pointed out on one of her last slides, we are looking at last August, early September. It will be as soon as we can do it right, but expect it in that time frame. Please check the website on a regular basis over the next few weeks to make sure you don't miss this time frame.

The street time for the NRA is going to be approximately 45 days after the release of the NRA, and there are always vagaries on exactly how long it is, but then that is our anticipation of minimum time. So the proposal will be due in early to mid October time frame, allowing ourselves proper review and evaluation period for that, and actual selection, we will put the selection date in the November or early December time frame, and then obviously allowing enough time to do the proper negotiations and making the award, we anticipate the early part of 2008, January, February, as when we are going to be doing this.

So that, hopefully, should set the time frame for you, the expectations, and response period in which you have.

As stated earlier up front, this entire process, this conference hoping to make that entire effort more efficient. It is better from our perspective. We have better confidence that we are going to get what we want from you, and also for your purposes, you have at least a cognizant head start on what we need, what our requirements are, and can respond sufficiently.

Question and Answer Session Follow-up

DR. CAVOLOWSKY: Let me open the floor again to any questions that may be residual. The doors are locked for the next hour.

[Laughter.]

DR. CAVOLOWSKY: Again, we are committed to making sure that any questions that you have will be posted and shared as Frequently Asked Questions as part of our website management of this, although you have an opportunity right now to share that with the community and to get some response from us.

MS. KIRBY: John, just to be clear, the information and the release of the NRA will be on NSPIRES, but DVD with request for materials from this will be on the Aeronautics website. Correct?

DR. CAVOLOWSKY: That is correct.

As I mentioned in one of those earlier slides, we are going to be taking a few days, a little time as we can, to gather all this information and have it burned on a DVD, and within a day or two, there will be a request process that you will see on the website. I encourage you to get on that. If you do want to have copies of all of this material, ask through the website process that we will set up in the next couple of days, and we will be happy to get it out to you.

We appreciate this information certainly from the context of these proposal time frames has a short shelf life. So we are going to do this as quickly as we can, so that you have access to it, but you have to ask.

PARTICIPANT (Ella Atkins): I feel like a plant here -- not really.

There were a certain group of people that due to late registration and so forth didn't get to give 5-minute presentations. Would it be possible for people to send slides, so that they can be included on this website along with the people that did have time to talk?

DR. CAVOLOWSKY: Managing a Federal website is

always a challenge with respect to access to everyone. Part of the reason we are going -- I don't think it will be possible, only because of the 508 compliance concerns. We need to be respectful of that. So I am afraid that is going to be too awkward, but thank you.

PARTICIPANT: Chris Wargo, Computer Networks and Software.

Oftentimes on acquisitions, they have interested parties lists on the website or people that have announced themselves to be prime, so you know who to go look for. Is that going to be possible?

DR. CAVOLOWSKY: What we are doing is making available every registrant that didn't request their information not be released be provided. So everyone that is here and is registered is available to you by name and contact info. Is that what you are asking?

PARTICIPANT: You have mechanisms of ways of people announcing that they really are a prime? Because some of the time is short here, although, yes, there is still 45 days between now and when you release. I was just asking. Thank you.

DR. CAVOLOWSKY: I am not sure I understand.

DR. PORTER: You are looking for beyond who attended here? Is that the question?

PARTICIPANT: I am trying to assist the teaming process. If certain individual companies want to list themselves as potential prime bidders, then the smaller ones will know where to go. The list becomes finite instead of 200 sort of.

DR. PORTER: Right. The challenges on the Government side, while we encourage teaming, we have to certainly be careful not to appear that we are forcing it or providing an advantage to one company -- Do you see what I am saying? -- or another.

So, for example, here today, everybody who registered, we can easily provide that information of who is here with their names and contacts, but there is a caution that we have to take as a Government not to appear to be forcing certain relationships.

I don't know if Gene -- our procurement officer is here, and he can probably comment on that. I don't want to misspeak.

Thanks, Gene.

MR. JOHNSON: Actually, I do understand the

question, but I think the gentleman probably would benefit from the fact that for this particular procurement, we have to understand that the NRA is already out there. It is on NSPIRES. This is not going to be a separate solicitation where we have a list of bidders and a list of companies that are going to be interested and they are brand new to the process.

What we are going to do, as John said, is that we are going to list the people who showed up here, and the way that the teaming is going to work out, it is going to be worked out amongst those folks who want to get together. They will figure out their own arrangements, but we will make at least a list of those companies available and the people who showed up. I think that is the key.

Did that answer your question?

PARTICIPANT: Yes.

DR. PORTER: Thanks, Gene.

DR. CAVOLOWSKY: Thanks, Gene.

PARTICIPANT: Hi. Ed Stevens from Raytheon. I just wanted to announce, we are interested in priming.

[Laughter.]

PARTICIPANT: So if people want to send us

materials they did not get, we would be very interested. Ed Stevens. You have my e-mail. Pauline Froemberg and Danielle Finkelstein [ph] are here today.

DR. PORTER: Earlier today, I made the point which is completely another avenue for you, and again, it doesn't identify primes and non-primes, but we do list all of our current NRA awardees on our website.

So, for example, I think here today, we have a little bit more on the ATM side than we do perhaps on the advanced vehicle concepts side, but we do have on our website a list of all the folks who are currently being funded under Juan's program and Herb's program and Karlin's program. So you can get a sense at least of who is out there and who is doing what by the titles of their awards and where they are at. So, again, if you are looking for a way to complement a potential team with a little bit more on the vehicle side, the safety side, I recommend you at least look there to get ideas. So that is certainly available to everybody as well.

PARTICIPANT: Greg Carr, Sensis.

This is more a technical question or process question on solicitation. We are assuming the ConOps from

JPDO is the starting point that we are looking at as a baseline to assess or do trade studies against. Is there a plan or a process or something in place, or is it safe to assume that you would want some of the outcomes of the research to feedback into the JPDO ConOps? Do you anticipate modifying the ConOps, or is it frozen?

DR. TONER: As Bob described to you earlier today, the ConOps is a description of what NextGen is going to look like. It doesn't tell you exactly how it is going to operate. So, from my point of view, it is open to some interpretation.

Now, all of NASA's research for NextGen really does feedback up to JPDO. We really do want that to transfer. So, yes, it will go back to JPDO. Yes, it will help inform the ConOps as well as help to inform our own research portfolio.

DR. PORTER: This is a wonderful psychology experiment. We will just keep waiting.

[Laughter.]

PARTICIPANT: I am Sheila Conway from Boeing.

We talked a lot about safety, and one of the things that has become very clear to me from a Boeing

perspective is the concept of certification. So one of the things -- this is more of a comment than a question, really -- is while you are looking at trade space between different opportunities in NextGen, we need to consider certifiability of any of these systems that we are talking about as well. Maybe you have some comments to that.

Thanks.

DR. PORTER: Herb, do you want to take that?

MR. SCHLICKENMAIER: Noted. Thank you.

DR. PORTER: John really doesn't have the doors locked, but --

[Laughter.]

DR. PORTER: In all seriousness, we have had some good discussion. Is this experiment in quietness indicative of we are done for today?

John, would you do me a favor, just in case anybody was sleeping, put up your POC information one more time, your e-mail address, just so people know?

DR. CAVOLOWSKY: That is one of the last slides. I call it the last slide.

DR. PORTER: Yes. I just want to make sure everybody knows, this is the person.

DR. CAVOLOWSKY: While this is coming up, Gene reminded me of a good point that the e-mail address that is listed under my name is an e-mail address that you can use to get the information about any NRA. We use that as a way to take in our information on this. So you can come to me, and I will respond to questions and things that come through on this regarding this particular NRA, but you can also use this to get to any question you have on any of the NRAs associated with the ROA 2007 for NASA. So I am just making that clear. I will get it, and I will get back to you as quickly as possible.

DR. TONER: Before we close, I want to take just a minute to thank the Mission Support staff who have really helped us put on this event today.

[Applause.]

DR. CAVOLOWSKY: Thank you, and we look forward to hearing from you all soon. Thank you.

[End of NSA Pre-Proposal Conference of August 9, 2007.]

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