Collaborative Combat Aircraft

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Brig. Gen. Jason Voorheis:

All right. Can we all hear me here? All right. Ladies and gentlemen, good morning. Welcome to day two of AFA, and to our panel Collaborative Combat Aircraft and industry perspective. I am Brigadier General, Jason Voorheis, the Air Force Program and executive officer for fighters in Advanced Aircraft. As you may have read in the press, the secretary of the Air Force has announced that the Air Force will field 1000 and likely many more CCA on an aggressive timeline to build affordable mass in capacity into the current Air Force Force structure. The FY24 president's budget makes a significant investment in the CCA program of record, which will leverage a consortium of nearly 30 industry partners with expertise in air vehicles, mission systems, autonomy and software development.

And this CCA industry consortium will continue to expand over time to sustain a vibrant competitive marketplace with planned competitive on-ramps consisting of both traditional defense industrial-based vendors and emerging small business and non-traditional vendors. We have with us today three industry leaders representing companies that will help aggressively drive the CCA market into the future. Our panelists are Mark Rettig from GE Aerospace, Tom Jones from Northrop Grumman, and David Alexander from General Atomics. I'd like to start today's discussion by providing each of our distinguished industry panelists a few minutes to introduce themselves and the companies they represent. Tom, why don't we start with you?

Tom Jones:

Okay. First of all, thank you very much general for allowing me to participate on the panel with you. CCA is a phenomenal opportunity and a great program we're very excited about, and I think it's going to be a really transformational capability for our air force and our country and their defense. As I look at this program, I think one of the key areas of focus here is speed to ramp. And I look at that in two different dimensions. One is getting this transformational technology into the hands of the warfighter very early with initial units allowing them to experiment, understand what the technology is like. And the second, because Secretary Kendall has been very clear about the fact that we need to keep timeline in mind is transitioning these capabilities into production to get to our warfighter as fast as possible.

So that implies a couple things to me. We have, if you've heard me talk on the B 21 before, there's a motto we had on that program, T-one like P-one, it means that we wanted our first test jet or our first prototype to be as close to production as close to operationally relevant as possible. And I think that that same mantra plays out in this particular venue. We need to make sure that those first prototypes we get to our warfighters are operationally relevant, and we need to start with the end in mind, which is we need to figure out how to make potentially thousands of these aircraft and to do it very efficiently and quickly. As I think about the problem making it through development, we are one of the leaders in autonomous aircraft. And I'll confess that earlier in my career, I spent about 20 years in autonomous underwater vehicles, including a bunch of time chasing those things around the ocean in a boat myself.

Getting autonomy right is not easy. We've got about 400,000 hours of operational autonomy in our product line. So I think really paying attention to making sure that we get operationally robust autonomy as a risk that we need to manage. The other, and final point I'd bring in my introduction is I've been talking a lot about digital engineering. We've seen a lot of the fruits of that play out as we've been able to eight years in still be holding to key milestones on the B-21 program. And I mentioned this at the classified panel yesterday that I spoke on B-21, we did all that despite the fact that there was a world

record pandemic followed by hyperinflation and supply chain. That says to me, if we can hold to a schedule using digital engineering, digital manufacturing technology in that environment, it holds great promise for helping accelerate programs in the future. Those are my high level intro thoughts.

Brig. Gen. Jason Voorheis:

Great. Thanks, Tom.

Mark Rettig:

Good morning. I'm Mark Rettig. I'm the vice president and general manager of our business and technology development at GE Aerospace Edison Works. We've been a partner with the U.S military for over 100 years. Today, two out of every three fighter and helicopter engines are GE engines. And we've been investing significantly to continue to support the U.S military. We announced last spring a $450 million investment in infrastructure, in equipment to support our manufacturing capabilities, test facilities and other manufacturing infrastructure to support all of the development and production activities that we have coming down the pike.

In addition to that, as we become GE Aerospace a standalone company, we are going through a significant lean transformation. Lean operating principles have become fundamental across the entire business, across the enterprise, and we're even pushing those down to our supplier base to make our suppliers make our business more efficient, more effective, work smarter, not harder. And as part of all of this transition and activity, we have several strategic initiatives that we've invested in significantly. Small engines specific to CCAs is one of those. We are investing heavily. We're partnered with another low-cost provider to give us a comprehensive team to address the needs of these kind of platforms. And we are well positioned to move forward in the space as this unique area evolves.

Brig. Gen. Jason Voorheis:

Great. Thanks, Mark.

David Alexander:

Good afternoon everybody. Dave Alexander, President of General Atomics Aeronautical Systems. So we are just super thrilled to be part of the CCA program. Of course, this is all we do is unmanned aircraft at our company. And I would say that our big focus right now is speed to capability that we're going to bring. And the reason I'm saying capability is speed to get to the first flight and parallel with that, speed to get to production so you have confidence in what you're designing, that you can go straight into production and speed to get the right sensor systems with open architecture, so this system can grow in the future. Our company has been around for about 30 years. We have produced, well if you count the latest aircraft, 30 different major aircraft systems that we've brought to bear. And so I think we're up to the challenge to bring a new platform quick and take it into mass production.

We've delivered over 1100 aircraft today. Primary partner has been with our US Air Force, and we're really looking forward to moving out on the CCA program and learning from the past some of the things that we got stuck with in the early days that we've learned from. And now we can make sure we design them in and have open architecture and agile combat employment and really, really make this an efficient program to bring mass to the fight. So a little bit about myself, my background is engineering and I've been in aerospace for 44 years. You're probably thinking, whoa, he must have started when he was about 12, but so 44 years all my experience has been unmanned flight since beginning targets and decoys and then since General Atomic since the beginning. And so we're going to bring everything to bear to this program and we're really proud to be on the team. Thank you.

Brig. Gen. Jason Voorheis:

All right, great. Thank you gentlemen for those opening remarks. I'd like to kick off the discussion with the first question related to the CCA business model. Both Northrop Grumman and General Atomics have been leaders in developing uncrewed systems for the last several decades. Under the CCA acquisition strategy, the Air Force is implementing several new approaches, government owned architectures, industry consortiums, shared development environments, and sustained competition at the air vehicle mission systems and autonomy levels. How do you see industry adapting to this new business model? And Tom, why don't we start with you on this one.

Tom Jones:

Okay. So I don't think I'm going to speak for industry, we've got other industry up here that can kind of flesh it out, but I'll give you the Northrop Grumman perspective. We've been operating in a lot of this environment already for probably at least a decade, the B-21 being a notable program, but there's other classified activities. We've also worked in consortiums. I've been working open system architecture for a long time, and we include small businesses across the whole gamut of things that we do. And I think that's important as figuring out how to work with these small companies, not just to bring the innovation and the agility that they bring, but to broaden the defense industrial base as well.

Now, one of the things, if you think about, so it's one thing bringing small companies to work in on a program like E2D or Triton where you're doing eight or 10 a year, it's a different thing when you're talking about potentially hundreds a year. So we work with small businesses on the F35 program where we deliver over 150 F35s center fuselages every year. That's one every approximately 30 manufacturing hours, that's high rate production. So if you're going to work with these small innovative companies, you also have to be able to collaborate with them and help make them scale to help make them successful. In terms of the question of ongoing competition, we pride ourselves on our performance. I mentioned performance on B-21 program. I think if you look across the board, we're pretty good at that. So I'm ready.

Brig. Gen. Jason Voorheis:

Excellent. Thanks Tom. Anything to add, David?

David Alexander:

Yeah. So I think I just focus on the continued competition piece, which I think is really key to moving forward, especially with autonomy and AI that we want to bring forward. And the key to that is it's going to be open mission systems, open architecture, and that includes command and control, and that also includes a sensor system. And so having that competition and that flexibility to bring new capabilities on and be safe, if you bring a new capability on and you have to go through the whole airworthiness cycle every time you go through it, you're going to fail. But if you can bring new capability in, new skills quick without going through an airworthiness cycle every time, that's when you're going to really grow your autonomy or AI over time. And that way this investment in this platform will evolve as it goes rather than get 10 years down the road and be stale and it's all vendor locked and you can't change it and to be relevant in the future.

So I really applaud the Air Force for setting the groundwork right this time. I've lived through a somewhat locked environment in the past, and then you build thousands of them and nobody wants to change anything. And I think here we're going to get on the right foot from day one with some really good requirements that have been set forth, and it will make the platform endure because you can

quickly make it more relevant as you go. This open competition for command and control, the HMI as well as the sensors and skills is key to the future of the program. Thank you.

Brig. Gen. Jason Voorheis:

Excellent. Thanks David. Something to add, Mark?

Mark Rettig:

Yeah, just to add. I mean we've been watching the unmanned space for a while. GE makes large engines, large, exquisite high performing engines. As CCA's come along, it's been a pull to attract us to the space. I think the fundamental thing challenge is the dynamics of the environment. We've been very, very focused on low cost and affordability versus exquisite and high capability. That's really driven us to partner with a low cost provider to bring that low cost culture and expertise. And we're looking low cost as a technology, as a capability, not an alternative to exquisite. And that investment in finding the right partner and working together has been fundamental to being able to compete or feel we can compete in the space. The other piece is scalability, finding a scalable configuration as the platform, as the challenges, as the requirements of the space evolve and being able to pivot quickly to provide a solution, a propulsion solution that enables whatever platform to perform and do the mission it needs to do.

Brig. Gen. Jason Voorheis:

Great. That was a good transition into a propulsion discussion. And as a follow-up to the remarks that you just made, the ability of the propulsion industry, supply chain and production capacity to serve the expanding market has garnered a fair amount of attention. What do you see as the greatest challenges confronting the industrial base for CCA as you consider the demand signal, not just from the Air Force, but from our sister services and potentially international partners?

Mark Rettig:

Yeah, I mean, so our supply chain is fundamentally important to us. We invest an enormous amount in it. The investment I mentioned earlier is critical to us being able to produce and support development production activities going forward. Building out our supplier base is the next step and expanding it to a lower cost base of suppliers that know how to do low cost manufacturing, low cost production, and building out that capability is critical. That's part of where our lean transformation, working with some of these smaller vendors and suppliers and getting them the capability and the tools they need to function at the level they'll need to produce in volume and in quantity is an area we're really focused on.

We're investing heavily right now. Being able to spool up our supply chain and our vendor base is critically important. Understanding how the platforms evolve when requirements are flowing down help us define our architectures, define our technologies, our materials, so we can flow that to our supply base and get them positioned well to meet the needs. Forecasting quantities and volumes and timing around that is also fundamental to that, to enable us to be ready in the timeframe you need us to be and respond quickly.

Brig. Gen. Jason Voorheis:

Okay, great. So changing gears a bit in the line of questioning, the Air Force, especially in the fighter portfolio, has historically pursued platforms with advanced exquisite technologies to overmatch our enemies. CCA on the other hand is prioritizing things like simplicity, affordability, and mass. Has responding to this demand signal challenge any cultural aspects in your company? And if so, how are you working through those challenges? Tom, you want to kick this one off?

Tom Jones:

Yeah, certainly. Thank you General. So a lot of people when you think about Northrop Grumman, obviously B-2I and B-2, exquisite small numbers of highly capable platforms, there's a lot more to the company. There's a lot more to the sector that I run. So a few people realize we also do the Center AFS on F-18. I mentioned before we do the center fuselage and all three variants of F-35 at high rate, I believe F-35 is the highest rate fifth gen production line in existence right now. We also do platforms like E-2D, and if you go all the way across the spectrum, things like Fire Scout, which is an unmanned rotorcraft for the U.S Navy. And in that platform, as we do in some of our command and control areas, we actually use an existing aircraft and we integrate capabilities onto those aircraft. So we really run the gamut in terms of what we work on.

Fundamentally, our company has a set of values, I won't recite all of them to you, but the one that I think applies here is we pioneer. If you go back to the original days of Leo Grumman and Naval Aviation, or obviously Jack Northrop and the Flying Wing, that's what we're all about. But CCA is a pioneering program as well. You don't have to be the James Webb space telescope or the B-21, the pioneer. We're pioneering new ways to get affordable mass out on very short timeframes. That is an exciting prospect. That's something that excites our engineers to operate on those types of time scales. I know I go down to our design spaces frequently and I interact with the engineers and see the excitement that they've got, but it's also exciting for all the other people that need to make this program work, not just about the engineering.

In fact, as I said in my opening comments, I think it's as much about producing an operationally relevant capability and to do that at the rates that we're talking about and the numbers that we're talking about, that's industrial engineers, it's manufacturing engineers, it's quality, it's global supply chain. Don't underestimate the global supply chain implications of this. On F-35, we move 10 million parts a year for 156 to 157 aircraft. That's a big challenge. Getting those parts in, getting them in on time, getting them kitted, getting them to the right place, those are the types of challenges we have to keep first and foremost in our mind as we look at this program. So I think it actually falls right in line with a lot of stuff that we do every single day. And like I said in my opening comments, this is exciting. The capability that we're bringing is exciting, and the time scale that you're asking us to perform on makes it exciting too.

Brig. Gen. Jason Voorheis:

Great. Thanks Tom. Mark?

Mark Rettig:

Yeah, and I'll touch on that too. I think the challenge for us and what really excites us about the space similarly to what Tom articulated is the novelty of designing in this low-cost environment. We characterize it, like I said, as a technology. There is a art to developing technologies that perform, provide mission capability, do what the services need to do at a low-cost point to enable affordable mass. And that is critical to us. What's also critical that I didn't mention with low-cost partner, making sure that we respect that low-cost culture, don't try to improve it too much as GE and find that balance in the partnership between the low-cost side and the capability that we bring, the scale, the production capability, the qualification and test capability, bring those to bear, but not disturb that low-cost culture that is specifically valuable to us and our partner, I think that's fundamental to being successful in this space.

Brig. Gen. Jason Voorheis:

David, anything to add on that one?

David Alexander:

Yeah. So as far as the culture piece, I would say General Atomics being a privately held company, I mentioned earlier that 30 aircraft that we've produced and a lot of them are still flying today, really started with inside investment within the company. And so I really feel like the GA DNA really fits the culture of the CCA program, which is, hey, let's move quick, let's move out, let's get it right and get the quantities up. So I think we got to be careful with low cost. I think it needs to be attrition tolerant, not at treatable, and you got to make sure that you're not producing a lot of something that will fail because nobody will want that as well.

And so I think it's just you have to get the reliability up and you have to get preventative maintenance and scheduled maintenance down and out so you can keep the manning low. And these are investments into our platform. And so I think we got to keep an eye on the big picture as far as cost goes, and there's a balance between a treatable and fault tolerant, and I think that's something we're going to have to, as we go through the program, make sure we don't lose sight of that and do something that we regret later on down the road.

Brig. Gen. Jason Voorheis:

Great, thanks. My next question has to do with speed to ramp. We've talked about that a little bit here so far. We need to get CCA in the hands of our tests and operator communities to innovate with crewed uncrewed teaming concepts of employment and to really understand how best to integrate CCA into the force structure across the full spectrum of doctrine, organization, training, leadership, facilities and policy. Consequently, a fundamental element of the air force's strategy for CCA has been speed to ramp. From your perspective, what design considerations specifically must the Air Force and industry prioritize to increase producibility on the one hand for CCA application and then to drive rapid fielding? David, you want to start out with this one?

David Alexander:

Yeah. I think in the beginning we were really focused on speed to ramp and testing through a surrogate would really be a big benefit to the program. We're doing that today on our Skyborg and MQ-20 platforms. And so that again, is getting back to doing things in parallel. Getting to that first flight, working on mass production, getting your production rate and your tooling up in parallel, and also getting your sensor systems going. So I really think surrogate testing can really bring along some of these skills that we're looking for and so that they all come together at the end and we're not doing all this serially I think would be a big benefit to the program.

And we have found that it's helped us with this Skyborg and MQ-20 effort because we have learned how to bring in skills, bring them in quickly, bring them in safely, and actually control the aircraft through tablets and do all this in a manner that we don't have to bring down the aircraft to go through a big airworthiness certification next time to get a flight release. So I think in summary, I think things in parallel and surrogate testing has really been a benefit for us.

Brig. Gen. Jason Voorheis:

Okay, thanks David. Mark, anything on that?

Mark Rettig:

Yeah. For us, speed to Ramp in large part is about investing now to make sure we're validating the design methodology to David's point to make sure that we have low-cost products that are reliable, that meet the needs of our customers. But getting those platforms defined and evolved, getting our supply

base in place and having them ready to perform, which goes to getting requirements and forecasts for when things are going to happen is fundamentally critical. And then making sure that we have a scalable architecture and validating that scalability, that in and of itself significant reduces time to ramp, especially as the platforms, this plan million of platforms evolves and we can take something that we've demonstrated proven, we currently have an engine on test as we speak and scale that engine to whatever the system needs to perform the mission it's designed for.

Tom Jones:

So speed to ramp, as I said in my opening comments, I think really comes on two different time scales. There's your initial time scale, get something the warfighter can start to experiment with, understand what the technology brings and then how do you rapidly get to a rate that generates the type of numbers that Secretary Kendall is asking for here? I think if you look at the near term, it really drives a need to reuse as much technology as you can. I look at this as being a integration program rather than a development program, if you will. But again, underneath all of that is that need to make sure that whatever you're getting out into the hands of the warfighter is something that's operationally relevant because the last thing you need in speed to ramp is doing two back-to-back design efforts in order to get something actually into production.

So again, I'll go back to that T-one, like P-one mantra that we have. I think that's incredibly important, not just because it's that operational capability that you're getting out there, but because it gives you the ability to flesh out everything that you need to move into production. You've got your production work orders, you've got your production tooling, you've got your production test, all of that is getting flushed out on the initial elements instead of is done a lot in industry kind of making a bespoke first article or first couple of articles and then go back and go, how do we build this on mass? So I think that's a pretty critical point here.

The focus on production I think is enabled a lot by advances that we've made in digital engineering. I think that also is going to burn down risk. Let me kind of tackle both of those. What we're seeing in ongoing internal investment efforts that we have right now on really getting a full interconnectivity of our digital tools is the ability to iterate significantly faster than we have on previous programs, even on B-21 for that matter. What that is enabling us to do is one, as I mentioned, hopefully that holds the promise of shortening timelines, but enables us to get those iterations in by pulling in. Now I've been doing this not quite as long as you, but 33 years. So I've been around doing this for a while and the whole time we've all been talking about it, we're going to get production and logistics involved in the front end of the design.

And the fact is those design iterations took so long that oftentimes they were there, but it was difficult to get all of their feedback incorporated in design. By tightening those design cycles up, we have much more opportunity to bring in manufacturing engineers, bring in logistics people and make sure we get those things baked in, which means a smoother transition into production. In terms of just reducing the overall risk, there's been a number of examples we've given on the B-21 program where we've been able to discover through our digital models things that had it happened in actual flight tests or ground tests would've taken significant amounts of time.

I'm a big believer in the ability of digital engineering and digital models and we're really seeing very good fidelity between our digital models and things that we're building. So that's kind of my look at speed to ramp, it's daunting, but I think it's doable. And I actually forgot one thing, critical, I mentioned it before as well, but can't leave speed to ramp without it. As you mentioned, getting our supply chain up to speed. That's going to be essential and it's at a point when supply chain is stressed more than it has

been probably my whole career if you look at some of the dynamics that are going on in the supply chain. So that's going to take a lot of focus and work.

Brig. Gen. Jason Voorheis:

Okay, great. I'd like to transition a little bit here to talk about affordable ONS, we're about 11 minutes to the end here. So what I'd like to do is I'll ask this question and then if you can fold in any concluding remarks that each of you have into that answer and then we'll end the panel. So in addition to driving affordable mass through unit production cost targets, which we've been talking a lot about, O&S costs are an equally important indicator of CCA success as an affordable mass platform and an agile combat employment environment. So from an industry perspective, what type of design characteristics must we consider in order to keep the CCA footprint minimal on the one hand and O&S costs affordable on the other hand? David, do you want to start with this one?

David Alexander:

Yes, sir. So again, it's key right up front to design the system for the vision of how you're going to operate and really, really important to all these open systems that I mentioned before, that we have that all in place, but we also allows us to bring in the automation and agile combat employment. And between those two, I think you're going to really see a big sea change as far as manning and extra labor that takes to have unmanned platforms in the sky. So those two elements and ability to improve them over time with open mission systems is I think really key to the manning part of this. The other important, excuse me, the other important part is designing a platform that doesn't need a lot of scheduled maintenance. If you have that in mind, you can set that up in the beginning that the time between overhaul on items are within the life of the platform.

How do you do fueling? How do you do weapons loading? All these things need to be considered ahead of time so that you don't get there and then realize you need all this equipment and people down range, which is not going to help getting this scale up on this and bringing masks to the adversary. So I think that's super important. That would be, I think the big sea change going forward is the automation, agile combat employment and minimizing any maintenance on the platform going forward. And you're going to have to design those things in from the beginning. You have to understand where we're going and what we're trying to achieve as key requirements going forward. And then as I would say, closing statement, we're super proud to be on the CCA team right now. And again, we've got 300 engineers with big smiles on their faces because it's a platform of the future and they really feel fortunate to be working on this endeavor.

And I think our company culture being privately held and being able to lean forward and forecast what's needed so that we can hit the production rates that we're looking for. And our experience with over 1000 aircraft field fielded, 8 million flight hours, we're deployed in about 72 locations around the world with 1000 people forward deployed at any given point in time. And so we have the soup to nuts of what it takes to bring mass to the field. We're flying 500,000 flight hours every year as we speak today. So anyway, thank you for the opportunity.

Brig. Gen. Jason Voorheis:

Great, thank you David. Mark?

Mark Rettig:

Yeah, I think what you touched on, David, about you have to focus on O&S costs, maintainability support ability when you're designing the system just as much as we need to focus on designing a system that's

low cost and affordable. One of the things I think that's basic to our design approach is rather than traditionally designing for capability and then trying to take cost out down the road, we're designing for affordability. You can add capabilities, you can add features, but to take them out is a challenge when you try to get back to a tossed cost target to design it fundamentally affordable, fundamentally low-cost, fundamentally maintainable I think is really the basis of our strategy.

Having a strategic partner that understands that and can deliver that in conjunction with the other things we bring to the table, I think is critical in us bringing the right system with what the services need from a feeling perspective, from a support perspective to bear on the conflicts we're looking at. In closing, I mean, geez, thrilled to be part of this. We've been looking, like I said, at this space for a while. A lot of the things that we're doing now align us very well to jump in. CCA is the pull that got us really excited about this. I think we have the right team, I think we have the right capabilities and I think we're excited to see how the space continues to grow and how we're going to play in it.

Brig. Gen. Jason Voorheis:

Great. Thanks Mark. Tom?

Tom Jones:

It sounds like we're giving our closing wrap with this answer as well, right?

Brig. Gen. Jason Voorheis:

Yes, sir.

Tom Jones:

Okay, sounds good. So a lot of what my previous panelists mentioned I think applies. You have to get maintainability in right at the design phase, and I think there's a lot of good examples of that. I mentioned B-21 a lot in this presentation because it's the most relevant recent design that we can talk about with a lot of good results. Getting the maintainers in their early, again, using that digital engineering environment, interacting virtually and augmented reality with what we think systems will look like to understand how we can get the designs right. Going to cloud-based ground segments so it can drastically reduce the footprint in these austere environments we'll be dealing with agile combat employment. But I think also it goes back into the platform and the type of the platform a little bit itself.

I think, Dave, this goes to a little bit about what you were commenting about affordable and attritable and where the price point is. If you think about the Indo-Paycom, there's big distances out there and you need aircraft that you can ferry around. And if you don't, you are getting a big logistics tail just to move between the different bases. So I think you'll actually see as you get into this that there's potentially trade points as you trade off range for additional logistics, tail for moving things around that needs to be balanced as you look at what the right total solution is to meet the requirements. In closing, it's about speed to ramp, right? It's about speed to ramp on both of those dimensions, which I think means one, make sure we deliver something that is operationally relevant so that we're not going back to do a redesign, get that T1 as much like P1 as possible and keep that focus on production. And that's it. Thank you very much for allowing me to be on the panel.

Brig. Gen. Jason Voorheis:

Great. Yeah. Thanks for the great discussion today from our panelists. Please let's once again thank our panelists for taking the time to share their industry perspective with us. And have a great Air Force day and thank you very much.