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THE FUTURE OF AIR FORCE LONG–RANGE STRIKE—CAPABILITIES AND EMPLOYMENT CONCEPTS

HEARING

BEFORE THE

SUBCOMMITTEE ON SEAPOWER AND PROJECTION FORCES

OF THE

COMMITTEE ON ARMED SERVICES
HOUSE OF REPRESENTATIVES

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HOUSE OF REPRESENTATIVES,
COMMITTEE ON ARMED SERVICES,
SUBCOMMITTEE ON SEAPOWER AND PROJECTION FORCES,
Washington, DC, Wednesday, September 9, 2015.

The subcommittee met, pursuant to call, at 2:02 p.m., in room 2212, Rayburn House Office Building, Hon. J. Randy Forbes (chairman of the subcommittee) presiding.

OPENING STATEMENT OF HON. J. RANDY FORBES, A REPRESENTATIVE FROM VIRGINIA, CHAIRMAN, SUBCOMMITTEE ON SEAPOWER AND PROJECTION FORCES

Mr. FORBES. Today the subcommittee meets to discuss the future of Air Force long-range strike capabilities and employment concepts. Our distinguished panel of guests testifying today includes Lieutenant General, retired, Robert J. Elder, Jr., Ph.D., faculty, George Mason University; also Mr. Mark Gunzinger, a senior fellow at the Center for Strategic and Budgetary Assessments; and Dr. Rebecca Grant, president, IRIS Independent Research.

These distinguished guests, we are glad to have you here. You have all done a lot of great work, and we look forward to your testimony this afternoon.

During World War II, America gained the ability to strike targets at long range with its massive bomber force. The Air Force flew thousands of conventional daylight precision bombing missions over Europe and Asia. Crossing thousands of miles of ocean, the war in the Pacific was brought to a decisive end by the nuclear strikes on Hiroshima and Nagasaki. From that point, the United States maintained the robust conventional and nuclear long-range strike capabilities needed to deter the aggression of hostile states and assure the security of our allies around the globe.

As the threat environment evolved, so have our capabilities. Stealth and precision standoff weapons enable our Navy and Air Force to penetrate anti-access environments. Our increasing ability to process, exploit, and disseminate intelligence, surveillance, and reconnaissance information helps deter future conflicts and deescalate regional tensions.

That said, our long-range strike capabilities must evolve further to address the range of challenges posed by the rapid and threatening rise of China; a resurgent and expansionist Russia; a subversive and terrorist-supporting Iran; and an unpredictable and provocative North Korea. China, Russia, and North Korea are established nuclear powers, and Iran, regardless of the negotiated P5 agreement, remains a nuclear threat in the not-so-distant future.

Adding to this complex security environment, I am concerned about Russia and China rapidly fielding highly capable integrated air defense systems and other anti-access capabilities. The proliferation of these weapon systems is eroding our ability to perform long-range strike with our legacy bomber fleet and standoff precision weapons, thus diminishing our ability to deter and respond to aggression.

The current state of our bomber force is of great concern. The newest B–52 bomber is 53 years old. In at least one Air Force family, three generations of airmen have piloted the Stratofortress in combat engagements from Vietnam to Enduring Freedom. As of September 2015, our Air Force bomber force structure consists of 158† total bombers—63 B–1s, 20 B–2s, and 76 B–52 aircraft—with an average age of 39 years. Of the total, only 96 are currently funded for combat service.

The Air Force plans on recapitalizing B–1 and B–52 force structure with a smaller fleet of 80 to 100 Long-Range Strike Bombers. As we grapple with the proliferation of anti-access systems in contested environments, dwindling force structure, and continuing budget constraints and uncertainty, it is critically important that we identify the long-range strike capabilities and concepts that we need for the future.

Once again, I want to thank our witnesses for participating in our hearing this afternoon, and I look forward to discussing this important topic.

With that, I turn to my good friend and colleague the ranking member of the subcommittee, Joe Courtney.

STATEMENT OF HON. JOE COURTNEY, A REPRESENTATIVE FROM CONNECTICUT, RANKING MEMBER, SUBCOMMITTEE ON SEAPOWER AND PROJECTION FORCES

Mr. COURTNEY. Thank you, Mr. Chairman, and thank you for holding this hearing on our Air Force long-range strike capabilities. Given the impending award of the contract for the Long-Range Strike Bomber in the coming weeks, this is an excellent opportunity to discuss the future of this critical part of our Nation's power projection abilities.

The Air Force long-range bomber fleet has long provided our Nation with a flexible and effective deterrent tool. From composing one the three legs of our strategic triad to providing a full complement of conventional long-range strike options for decision makers, the ability to project power and convincingly strike from far distances is one of the most important components of our military arsenal today.

Our long-range strike fleet, composed of our B–52s, B–1s and B–2s, are also amongst the oldest aircraft inventory today. However, the current timeline projects that the Long-Range Strike Bomber will not actually be ready for operations until 2030, adding 15 years to the average ages of our existing bombers, effectively making the B–52 eligible for Social Security by the time the Long-Range Strike Bomber comes online.

† Correction for the record: The total number of bombers is 159.

I am interested in hearing from our witnesses about the kinds of ideas they have in regards to sustaining our current fleet in the years before the new bomber comes on line as well as lessons that we should draw from the longevity of these aircraft as they would apply to this new class. The strategic importance of demonstrating our Nation's long-range strike capability cannot be overstated, especially as it applies to the Asia-Pacific region. As noted by one of our witnesses today, Lieutenant General Elder, our bombers were an important part of deterring North Korean sabre-rattling in 2013. When B–52 bombers flew 6,500 miles from Missouri to South Korea to drop bombs on a test range, North Korea quickly toned down its threatening rhetoric, and the bombers effectively deterred further provocation in a volatile region.

As our near-peer competitors, especially China, develop formidable anti-access/area denial technologies, our ability to maintain a military advantage hinges on our ability to penetrate those defenses. I hope our witnesses will share their views with the committee on how the Long-Range Strike Bomber and long-range strike capabilities generally fit into the strategic priorities of the Asia-Pacific rebalance.

This new program is going to occur at a time of intense budget pressure, not just within the Air Force alone but also the entirety of the Department of Defense. Yet, with the aircraft expected to be in service well into this century, it is important that we get this right. As such, it is important that this panel and this Nation fully understand the challenges ahead and the options available to ensure that we retain a credible and robust long-term strike capabilities well into the future.

Thank you again, Mr. Chairman, and I look forward to the discussion today.

Mr. FORBES. Thank you, Joe.

And I guess we are going to line up.

If you guys are comfortable, we will start with General Elder and work our way across.

General, we look forward to any comments that you may be willing to offer us today.

STATEMENT OF LT GEN ROBERT J. ELDER, JR., USAF (RET.), PH.D., FACULTY, GEORGE MASON UNIVERSITY

General ELDER. Thank you, Mr. Chairman and Mr. Courtney, members of the committee, it is a privilege to have been offered this opportunity to talk with you today about the value of the Long-Range Strike Bomber to U.S. national security. As both of you have already mentioned, our capabilities are withering, and we have less than 100 combat-ready bombers with an average age of 38 years.

Quite frankly, the older bombers we have are simply not survivable in the face of modern air defenses. And as you pointed out, we are going to have to live with them for quite a bit longer. The newer B–52s remain potent but are few in number. And my belief, quite frankly, is the 80 to 100 aircraft number is not going be enough to replace the B–1, B–52 fleet, even though its capability against a target set will be greater, but what amounts to the rotational commitments, it is not going to satisfy that.

Unlike most military systems which are designed to provide utility for a small number of missions, bombers provide value in time of peace, crisis, and conflict. It takes many different platforms combined to do all the things that a bomber can do. Long-range strike bombers serve as a global strike air sensor platform, but they are distinctly capable of providing a range of effects against dynamic targets anywhere on the globe, and they can use their own organic queuing.

Study after study has shown that bombers do more than simply strike targets. They offer structural stability for both conventional nuclear scenarios and, as you point out, provide the most flexible component of the U.S. strategic triad. And they are the best way to reassure allies of our commitment to extend a deterrence because they can signal. In other words, the bomber is more than just a strike and sensor platform; it is also a powerful tool of diplomacy.

Long-range strike capabilities provide the Nation practical alternatives for global security and regional stability and provide combatant commanders increased effectiveness in the conduct of joint operations across the full range of conflict. They are absolutely critical for our national security. Because of their versatility, I believe they provide the Nation exceptional value, and I look forward to getting your questions, Mr. Chairman.

[The prepared statement of General Elder can be found in the Appendix on page 27.]

Mr. FORBES. General, thank you.

Mr. Gunzinger.

STATEMENT OF MARK GUNZINGER, SENIOR FELLOW, CENTER FOR STRATEGIC AND BUDGETARY ASSESSMENTS

Mr. GUNZINGER. Yes, Chairman Forbes, Ranking Member Courtney, members of the subcommittee, thank you as well for inviting us to talk to you today about this really important topic.

I would like to suggest a framework that might help you think about the LRS–B [Long-Range Strike Bomber] and other capabilities in the long-range strike family of systems. Now what I postulate is two competitions. One we call the hiders-finders competition; the other is a salvo competition.

Now the hiders-finders competition, what that is about is developing the capabilities to penetrate contested airspace, contested areas, and an enemy, a thinking enemy who develops countermeasures. It is a cycle. As we develop advantages, they develop countermeasures. Keeping advantage in that cycle in this competition is critically important.

In the 1950s, for example—the B–52 was designed about then; 1952 I think was the first flight—the most significant threat to our bombers was aircraft, interceptors, and surface-to-air fires—artillery. So the B–52 was designed to fly at high altitudes, and they gave it a gun in the tail to defend against fighters until SAMs, surface-to-air missiles, came on the scene in the latter half of that decade in the early 1960s. So the Air Force adapted and started flying B–52s at low altitude so it could terrain mask and hide in ground clutter, and fighters couldn't find them effectively, and it designed the B–1 to be a low-altitude, high-speed sprinter to penetrate contested airspace.

Until, about 1979, DOD [Department of Defense] announced that, well, Russia, or the Soviet Union has developed "look-down/shoot-down" radars for its fighters, capable of fighting our bombers at low altitude. So they started a program called the Advanced Technology Bomber Program, which led to the B–2 program to buy 139 B–2s to replace the B–52, and that would be a high-altitude stealthy penetrator. 1990, end of the Soviet Union, we essentially disengaged from this competition. DOD shifted its attention from preparing to fight two regional conflicts against North Korea, Iran, Iraq. They didn't have advanced air defenses, so while it continued to invest in stealth technologies for future platforms, it stopped the B–2 buy at 21 aircraft. And it also shifted the weight of its effort in terms of strike campaigns toward its fighter forces under the assumption that, well, we will be able to deploy our fighter forces very quickly into a theater of conflict, stage them at bases on the borders of our enemies; to bring the high-volume fires. We just didn't need the bombers to do that after the opening stages of a conflict.

The problem is our competitors didn't stop. China, Russia, Iran, and others have developed advanced air defenses—developed them or bought them—that are a real challenge to our current force. So while we modified our current bomber force to stay current and give it new radars and so on over the intervening years, we didn't invest in a new bomber.

Now the second competition is what we call the salvo competition, and that occurs between two adversaries who both have PGMs [precision guided munitions], not just the ability to attack with precision but also defend against the PGMs of an enemy. That is the situation we have today, certainly with Russia, China, North Korea, and Iran. They have capabilities to attack our bases in the western Pacific and the Middle East, all of them. So the assumption DOD made in the 1990s, it said: Well, we will rely mostly for strike on our fighters, and we will stage them really close to bases. Those bases are now at risk. That is an increasingly risky proposition. But we can compensate for that by beginning to use bases that are further away from our adversaries that, frankly, are out of the most immediate threat, out of range of those short-range cruise missiles and ballistic missiles.

And we can also disperse our fighter forces at those close-in bases to expeditionary airfields, civil airfields suitable for military use, as well as military airfields, to complicate the targeting problem of our enemies who have their own PGMs. So what this suggests, both the hider-finder competition and the salvo competition, is we might start thinking about reversing priorities that we established for bombers and fighters back in the 1990s.

Perhaps future air campaigns, the weight of the strike should be provided by long-range strike capabilities. They are stealthy and have large payloads staged at more distant bases. Whereas our fighters at the close-in dispersed posture provide counter-air, help kick down the door, provide close-air support, and other missions rather than relying on those fighters, which have about one-tenth the payload of a bomber and one-fifth the range of a bomber primarily for strike.

The Air Force has made a great start—and DOD has as well—at reengaging in both these competitions with the LRS–B, but it is just a start, and it is only one element of a long-range strike family of systems, which I hope we can get into in your questions. Thank you.

[The prepared statement of Mr. Gunzinger can be found in the Appendix on page 35.]

Mr. FORBES. Thank you, Mark.

Dr. Grant.

STATEMENT OF REBECCA GRANT, PRESIDENT, IRIS INDEPENDENT RESEARCH

Dr. GRANT. Thank you very much for the opportunity. As my colleagues have said, America's bomber force is one of the truly unique tools of our national security and our international diplomacy. Sadly, today we have at any one time only 16 combat-ready B–2 bombers that are able to take on the most heavily defended types of targets, and it is this situation that we are setting out to correct.

I want to speak very briefly to the capabilities and employment concepts of the bomber and then touch on how the Air Force will manage this program. The first capability, of course, is access, and that does still very much mean stealth. Stealth remains a fundamental design requirement, and we should expect to see improved stealth techniques that have advanced beyond the B–2 and will include electronic warfare and other state-of-the-art survivability techniques.

Range and payload, of course, are what define a bomber and separate it from other types of aircraft. Recall that every bomber design has had to make a tradeoff from the B–17 right to the B–2. So we may expect to see, of course, excellent range, but that will be defined as range from leaving the tanker track. Payload will be a mix of munitions, both the small precise munitions and the heavy munitions for hardened and deeply buried targets. We don't know what parameters the Air Force has chosen this time, but we will expect to see something that has blurred the distinctions between global and theater attack.

Also I think highly important and new in this Long-Range Strike Bomber program will be an open software architecture. That will be very important because this bomber will be new in its communications and data link relay abilities. It should be able to immediately join not only the SATCOM [satellite communications] but the aerial layer networks, those IP [Internet Protocol]-enabled networks that now define the gold standard in battlespace communications.

We expect, of course, for this bomber to roll off with the basics of nuclear capability installed but to proceed to certify that capability quite a bit later after it completes initial flight tests. Most of all I want to see some upgrade capacity here in the winning design. Our bomber will reach initial operating capability perhaps in the mid-2020s—or just a touch later—but continue to operate and fly missions until 2055 and beyond. This bomber, therefore, has to have the ability to do what is asked of it now and also to do a bit more as we look for upgrades and new mission capabilities over

time. That means planning now for the airframe with the classic power, space, and cooling, and ability to accommodate those upgrades.

What will this bomber do specifically? It will, of course, participate in the battlespace under joint force commander direction. It will draw on ISR [intelligence, surveillance, reconnaissance], on tankers, and many other things. It will be dependent on stealth fighters, too. But it will have some very unique roles, and those include direct attack; the ability to drop a bomb; not a cruise missile, per se, because cruise missiles are—and other standoff weapons—are not always of capable of taking out every type of target this bomber may be assigned to strike.

We expect that targets in the future that are the most difficult will be a combination of mobile and of separate deeply buried targets. This is a very tough target set, and we need a penetrating bomber with the ability to take out those targets and hold them at risk. We also will see perhaps extensive target sets. A consideration we might not have thought through 5 years ago, but the bomber force here remains a unique strategic tool. It will have to do things like suppress airfields; counter enemy air defenses; and perhaps help hunt, destroy, and contain enemy surface naval vessels and submarines. This points us towards a highly capable force but one that also is big enough to be persistent across these missions. And I echo General Elder's concern; 80 to 100 is a start. I think closer to 150 might be better to assure the persistence in sortie generation.

Let me conclude with a remark about risk reduction and how the Air Force will manage this program. We all are awaiting a down select, and we want to see the best possible stewardship of this important national security capability. The Air Force says that it has taken a rather different approach with this bomber. It has funded both teams to conduct extensive risk reduction of the designs. What this means to us is that the winning design will be far more mature than other types of aircraft programs. And specifically, I believe, quite a bit more mature than the B–2 at a comparable stage of development. This winning design should go into EMD [engineering, manufacturing, development] with some critical work already carried out. For instance, the Air Force has said that they have identified specific risk areas to include propulsion integration—that is the engines—and integration of apertures and antennae, and conducted specific risk-reduction work in these areas. This again marks a bold and different approach, something quite distinct from what we saw with B–2, F–22, or F–35. This means that the Department of Defense's final choice of a winner should reflect analysis of capability, of the ability to proceed quickly through engineering, manufacturing, and development. And it should also reflect some analysis of the winning team's ability to proceed directly toward manufacturing.

To sum it up, the Air Force appears to have taken a rather bold approach, and what this means is we should expect to see a far more mature design. That should also give us in the end confidence in two things: One is the ability to adhere to cost targets from the EMD phase forward; and the second is that the Air Force should be certain that its winning design really has those mandated capa-

bilities and the extra margins that it needs, not only for upgrade capacity for the future, power, cooling, et cetera.

Of course, there are many things in the end that can affect a program, but the risk reduction is unique in this case, has been carried out with a great deal of forethought, and I think should give us a very confident basis from which to proceed to develop a new Long-Range Strike Bomber. Thank you.

[The prepared statement of Dr. Grant can be found in the Appendix on page 49.]

Mr. FORBES. Before we go to Mr. Courtney for his questions, can all three of you give us your thoughts about what happens if we don't get this long-range strike capability? And number two, how do you assess so far the process that we've used to get here as you look at the Air Force and what they have done? What is your thought on that?

General Elder.

General ELDER. Mr. Chairman, that is an interesting question, I think the Nation will be in quite a bind, quite frankly, particularly with the threats that you highlighted in your initial marks, if we don't get this new capability, the Long-Range Strike Bomber. There is a perception that things aren't too bad right now. We seem to be holding things in check with the current force structure, but the reality is that our adversaries do know how to go after our strengths. They are looking for ways to exploit that. Actually, as Mark Gunzinger pointed out, this going back and forth, the LRS–B is a huge jump over where they are in terms of their ability to counter it. So it will be important from that standpoint.

I also believe that as a Nation the types of things we do when we talk about our ability compared to others, what perhaps makes this a superpower is this capability to operate globally. And these other airplanes we have are getting too old, and so we basically will wither down to where we basically in the future will only have the B–2 fleet and then forces that we can deploy. These deployable forces are very important, that they provide a capability to operate globally, but they don't give you a global capability. And certainly from a time standpoint, in terms of giving options to the President, any adversary knows that there is going to be this long period of time before you would be able to get there. I think that is going to raise huge concerns among our allies, who are counting on us not only in some cases for nuclear umbrellas but also for kind of a strategic stability globally. And, of course, the bombers have been working for years now with the sea forces in terms of providing stability. Particularly in the Pacific, but not only there, in Europe and the Central Command region as well. So I think it would be disastrous for the Nation's force not to get this new airplane. It will be critical to our national security in the future.

In terms of the process that was used. It is interesting that one of the challenges we have had when you try to bring out these new technologies and you want these new technologies to give you this asymmetric advantage, that asymmetric advantage works for a period of time until the adversary knows what they are, and then they are going to start trying to work these counters. So the one good thing about this approach for sure is that this whole period of time, the adversary knows that something new is being devel-

oped, but they have no opportunity to even start thinking about how they might counter it. There is a lot of discussion about ways it can be approached, but those things all depend on pretty fragile knowledge of how that would happen. So from a standpoint of trying to protect the way this airplane is going to give us this asymmetric increase in capability, I think it is a good thing we have done this because it basically saves the government a lot of money. It also means that when this airplane is produced, it has quite a bit more capability from the get-go.

The second thing, which is actually something that Dr. Grant pointed out, the airplane is designed to be able to continue to evolve with technology and with new threats because of the open architecture design. And so once the airplane is something that people can actually see and our adversaries can see, we will know that they will start working to look at ways to counter that. But it will be much easier with this platform than platforms we have had in the past to be able to bring those changes in and continue to maintain the LRS–B as a relevant platform for a very long time.

Mr. GUNZINGER. Excellent question. I am going to give you the U.S. perspective—our U.S. perspective—and an enemy's perspective on this question. First, we throw around numbers about the size of the force, and how many are combat capable and total aircraft inventory and so forth. Today our Nation can launch about 12 B–2 sorties on any given day. If B–2s have to operate from Guam or Diego Garcia in the Indian Ocean, that is about 12 sorties. That is our Nation's long-range penetrating strike capability and a handful of standoff cruise missiles. If we don't buy the LRS–B, well, the B–2 eventually will not be able to penetrate into China, into Iran, and some other areas. The B–1s and B–52s already can't penetrate into those higher threat areas. So we will be a Nation that will be able to fight on the periphery of some of our potential adversaries in the future.

From the enemy's perspective, it would create a one-dimensional problem for them. All they have to do is defend against these standoff capabilities. They can project power out to attack our bases, to attack our aircraft orbiting to launch standoff cruise missiles and so forth. They don't have to defend their interior. Those deep targets are not at risk. So they can pour their money into their outer defenses and into offensive capabilities instead of having to defend their interior. So that would not help us impose costs on an enemy at all.

Mr. FORBES. Dr. Grant, how do you assess where the Air Force has come so far in this process?

Dr. GRANT. In the process? In my opinion, the Air Force has taken a very deliberate and careful path. It has chosen an unusual and very, I think, successful acquisition strategy as it works through the process of taking the two teams down to contract award.

I personally wish that the Air Force and the Department of Defense would minimize some of the classification around the acquisition aspects of the program, obviously not jeopardizing national security capabilities, but I would like to see the Department of Defense tell us a bit more about how they have conducted this process. Based on what the Air Force has said, they have taken un-

usual steps to take risk reduction much further than in any program we have seen in many a decade.

Mr. FORBES. Mr. Courtney.

Mr. COURTNEY. Thank you, Mr. Chairman.

In terms of just trying to assess the value, which the chairman's first question certainly zeroed in on, obviously, this program's ability to operate jointly with other branches in terms of the Navy or ground forces, I was just wondering if you could maybe help us sort of understand the value from that aspect.

General ELDER. That is a great question, and one of the things about this particular airplane—although when you are operating in a contested environment and people are shooting at you, you definitely don't want to present yourself as an easy target. But if you were to look today, even where it is relatively an uncontested environment in Afghanistan and you look at where the bulk of support to our ground forces is coming from, it is actually coming from B–1s that are providing that close air support. That wasn't something that was really that easy to do before we had the weapons we have today. They have the same type of targeting pods that the fighters have; they have the GPS [Global Positioning System]-guided weapons. The big thing they can do is they can persist for a long time and get there quickly. And because of that, you can provide quite a bit of coverage. So it is invaluable from that standpoint.

If this were a contested environment, those airplanes wouldn't be able to just loiter there because they would become targets themselves. So having that advanced stealth, while not going to be a panacea, but they will have a capability to operate that our current platforms would have difficulty being able to operate in. From a naval standpoint, there is a different way of looking at this, and it goes back to all those—I guess it is going a little bit out of vogue now, the whole AirSea Battle.

But there are advantages to air forces and vulnerabilities, and there are advantages to sea forces and vulnerabilities. But it turns out that when you put those together, they are actually pretty complementary, and that was the whole idea behind AirSea Battle: Let's take advantage of some of the things that the maritime force can do to help make the air forces be more effective and vice versa. This platform operating in conjunction with maritime forces is going to be able to do quite a bit. One of the things is, as a sensor platform itself, it is actually going to be able to see targets and relay that information back to where a maritime force could be launching weapons as well.

And if you understand how special forces operate, there is a nice advantage to that because if you have one group that is actually doing the surveillance and another one is doing the shooting, you don't give away your surveillance position when you shoot and then you can leave. So operating together, you are going to have a nice complement there.

Without going into any classification, there are a lot of things that maritime forces can do from a sensing standpoint. I wouldn't want to go into detail here; the committee I am sure is well aware of those. That information can be used to make bombers more effective and actually also help protect the bombers. So you can see that these different forces are supposed to have—particularly when

you are talking about undersea forces—have their own kind of stealth, a different kind of stealth but they are a stealthy force. You put those together, and it provides a very complex environment for an adversary to believe that they could defeat us. That is useful not only actually when you go to fight, but when someone is trying to think about fighting, they might want to give it a second thought and say: You know, they have so many different ways they can deal with us; we might think we have a leg up, but in reality, we can't be sure because particularly when they put these capabilities together, we have no idea just how significant those forces, the synergistic capabilities that would come from bringing those forces together, would be.

Mr. GUNZINGER. Back when the debate was hot and heavy over whether or not we should start a new program, and I was still in the Department of Defense, the Air Force started looking at the problem as a families of systems problem. It is not—it wasn't rhetoric, and it is not rhetoric today. This isn't about, what should the Air Force buy to maintain its capability? It was, what does the joint force need to be able to maintain his capability to strike an enemy deep, to threaten and put at risk all of his most significant targets.

Family of systems encompasses airborne electronic attack, penetrating ISR capabilities, service-based capabilities, carriers, submarine launch, cruise missiles, the whole family. So this was—it was born out of a concept to develop the future of long-range strike family of systems and also to figure out how it would be integrated in joint operations, not just what it could do to improve Air Force operations, but the joint force operations for the future. So I think that is a very important thing to keep in mind as you assess the value of the LRS–B. It hopefully will be able to execute missions in support of the Navy, for example, anti-surface warfare. Why not have the LRS–B capable of launching more LRASMs, Long-Range Anti-Ship Missiles, in the future? They can carry a lot of them, I hope. They will be able to cover large areas at sea and will have great sensors for wide-area surveillance, a perfect supporting mission for the Air Force to support the Navy. It may even be able to do future air dominance. Given enough space, weight, power, and cooling capacity, perhaps it could carry air-to-air missiles and, in the future, lasers to help support not just the Air Force but the Navy to counter enemy aircraft.

Mr. FORBES. The gentleman from Texas, Mr. Conaway, is recognized for 5 minutes.

Mr. CONAWAY. Thank you, Mr. Chairman.

Thank you for being here.

Being the only CPA [certified public accountant] on the subcommittee panel, I'm trying to do the math. The original version was $550 million a copy? At just—$31 billion or $33 billion was the original cost. How do you buy 100 at $550 million apiece for $33 billion? And how does that get less at $41 billion or $58 billion?

Mr. GUNZINGER. Right. Well, the answer is, you don't. The $550 million number was procurement costs in fiscal year 2010 dollars. It did not include EMD, and of course, it didn't include inflation that will occur year by year. Plus, the number that you are citing—

I think $33.1 billion—that was between 2015 and 2025. I am pretty sure.

Mr. CONAWAY. So you are not buying 100.

Mr. GUNZINGER. Not by 2025, that is correct.

Mr. CONAWAY. Okay. So, Ms. Grant, you mentioned that the Air Force is using a different procurement program that is successful. Maybe I got lost in the conversation, but the most recent—about the F–22 and F–35, how is the Air Force going to avoid—the years on the F–35 or the F–22, mid-1980s to 2006—so how does the Air Force avoid doing that same thing again?

Dr. GRANT. That is a very good question, and the first step of many in that is to go forward with a design that is closer to being ready to produce and go into flight test. And here I applaud what the Air Force says it has done, which is essentially to wait awhile on the award process. So instead—as was the case with B–2 in 1981, with F–22 in 1990, and F–35 in 2001—you can do this either way, but in those prior programs, the Air Force did less analysis of the contenders prior to EMD. What they say they have now done building on some lessons of the past decade and using a different procurement organization, the Rapid Capabilities Office, which is a joint body between—obviously run by DOD—but with DOD and Air Force leadership.

Mr. CONAWAY. How does that circumvent the normal procurement process?

Dr. GRANT. It is within the process, but it would have——

Mr. CONAWAY. Is that the same group that did the MRAPS [mine-resistant ambush-protected vehicles] and body armor?

Ms. GRANT. They apparently have done a great many things, but I am not sure of those specifically. Once this is done, if I may just address the case of Long-Range Strike Bomber, the Air Force says they have used a smaller team. They have funded both teams to do much more extensive risk-reduction work. So they have asked them to analyze not just how this aircraft will look and fly and meet some minimum standards, but to look several layers down into the produceability and maintainability. That is a very important step one. Sir, as you rightly point out, there are many steps to come with this, but moving into EMD with a more mature design is the best possible start for this to really set a new path and get us the capability more quickly and on cost.

Mr. CONAWAY. From a complexity standpoint, the F–35 was a more complex platform than this or less complex?

Dr. GRANT. A difficult analysis to make. You know what? They are both very complex aircraft. All right? I would say F–35 is more complex because of its tri-service and allied requirements. And one more thing I think is important for us to understand: The Long-Range Strike Bomber will build on the lessons of at least the past two decades in development of stealth, integration of AESA [active electronically scanned array] radar, and many other things. So I think we are looking at a bomber program that this time is building on things that are already in hand, maybe even some things you and I don't know about, but that they know about and are able to put this into production more quickly. So I think they have done—by using more mature technology than we have seen in cases where technology had to be developed to meet the require-

ments, we see really a conservative approach to a great new capability.

Mr. CONAWAY. Okay, is it fair to say, without describing what we are talking about, that there were certain breakthrough technologies on the F–35, that you won't have to reinvent that wheel on the bomber, that would shorten the delivery time?

Dr. GRANT. Right. Obviously, as we haven't done source selection, we don't know what we are talking about, and I'm not an official. But you are absolutely on the right track. What B–2, F–22, and F–35 asked was to develop technologies in order to meet those thresholds. Long-Range Strike Bomber I think will have some great new stuff but is able to take advantage of more mature technology development in several key areas, and that should make a difference.

Mr. CONAWAY. I yield back.

Mr. GUNZINGER. I absolutely agree, the B–2 and F–22 are more inventions than the LRS–B. LRS–B is more of an integration program where it is taking very mature technologies from other programs, maybe even actual components and engines, and integrating it into a new platform that is going to be much more capable than the B–2 and other systems.

It is also I think important to remember that it has been about 10 years since the 2006 Quadrennial Defense Review [QDR] said: Let's start a new program for a penetrating bomber. And there was a previous program to do that that was canceled in 2009. But the knowledge and technologies and the skilled workforce that were dedicated to that effort, they are still around, and they were able to pour a lot of that knowledge and technology into this program.

Mr. FORBES. The gentleman is exactly right, though, on the cost situation. We are going to have to have a discussion with the Air Force. I don't think there was any bad intention or anything there, but still those numbers, it is a big gap from 33 to 58 and then back down we think now to about 41, but still a huge discrepancy.

The gentlelady from Florida, Ms. Graham, is recognized for 5 minutes.

Ms. GRAHAM. Thank you so much. Thank you again for being here today.

We talked a lot about what has gone into developing the proposed next generation of LRS [long-range strike]. Are we also looking at the adaptability for the future so that whoever is seated here 10 years from now isn't talking about an already obsolete LRS that we are again having to invest in building new aircraft? Something I think we all should be focusing on is we know what we are capable of today, but are we looking into the future in order of adaptability so we are not pouring additional—huge amounts of resources into future aircraft sooner than we need to? Thank you so much.

Dr. GRANT. If I may start with that, an excellent question. I think two things are highly important: One, our aircraft today are so information dependent. This new bomber will have a tremendous advantage because it is not like the B–2 that needs to be upgraded or B–52. It will come out with that open mission system architecture. That means that we can add devices in almost as easily as if you add an app [application] on a phone. So that is a tremendous advantage in keeping it relevant.

The Air Force has also said that they intend to fund the science and technology development for continual upgrades and to feed that funding line through. So, yes, I think we have every confidence that it will be able to be upgraded and stay relevant across that 40-year service life.

Mr. GUNZINGER. Five years ago, before there was an LRS–B program—I have to caveat, I like that—CSBA [Center for Strategic and Budgetary Assessments] put out a report for the need for a new bomber and how it might be developed in a different way. We recommended that the first thing you do is ensure it has enough space, weight, power, and cooling so you could adapt it to new missions, integrate new components in the future, perhaps lasers, for example, to take on the air-to-air missions.

But the second thing is to develop it so you can upgrade it or integrate block upgrades over time, to refresh its technologies, to be able to counter new threats as they emerge, to take on new missions. If you design it with the idea that you are going to be able to do these block upgrades over time, then you greatly reduce the risk that when it is produced and it is on the ramp, it is not going to be outdated. The second thing is it helps you to spread the cost over time because you buy new capabilities for these block upgrades rather than try to get everything into the first model.

General ELDER. Not to beat a dead horse, but one of the things about this airplane is that they really were smart about this. I was pulling out some testimony from Mr. LaPlante, who is the acquisition head for the Air Force, and this has been a big deal for this program, this concern about the fact that when they buy bombers, they have them for a long time, and they want to make sure that they can continue to bring these new capabilities in.

The other thing that Dr. Grant pointed out is about this information piece, but the other thing I realize now—I don't know what the percentage is, but the percentage cost of an airplane these days, actually any system, military system, a huge amount is actually caught up in the software, the code that is being written for these systems. What they are enforcing here is the use of what the Air Force calls open mission systems. The Navy has a slightly different name. It has actually been mandated by OSD [Office of the Secretary of Defense], by the Department overall, that you have this. What it allows for is plug and play. They have different levels of integrated capability, but just ask for an iPhone or an Android, someone else can write the application besides Apple or Google, for example. You have the same thing here, and when someone has a better idea, they will be able to write that, test that module, and then plug it in. They won't have to go through the complete end-to-end test, which is what has driven us to these block upgrades in the past, where it was incrementally done. Now, as soon as you can write these things, you can plug them in. You also can also add new systems to the airplane because they are working with open standards in terms of the plugs of plug and play for actual boxes that would go into the airplane.

So as we look to the future, as I mentioned to people in the past, the people in this room have no idea what this airplane is going to be able to do because we haven't given them to the captains yet. When the captains get a hold of this airplane, they are going to

say, well, we can do this with this; the airplane will do this. The things that the B–2 does today, a lot of those things were never imagined until it actually got into the hands of these brilliant young captains to think about how to do this. The same thing is going to happen with this. The difference is that when a captain in 2025 gets a great idea, if I could just write a piece of software, it would really help me out, they are going to be able to do that in 6 months to a year, instead of having to wait for a 3- or 4-year block upgrade. That is going to be the huge difference with this platform.

Ms. GRAHAM. All three terrific answers. Thank you very much. I appreciate it. I don't have any more time, but thank you for being here. Again, I appreciate it.

Mr. FORBES. Colonel Cook is recognized for 5 minutes.

Mr. COOK. Well, I am going to apologize in advance; I am going to be the cynic here. And, once again, at least with me, I am not as smart as you guys. If you are going to talk with a bunch of acronyms that I don't understand, right away my eyes start to gloss over. If you could kind of "keep it simple, stupid" for me, I would appreciate it a little bit.

You know, I am probably one of the biggest hawks on this committee, but it bothers me about things in the future and the amount of money. And maybe I have had too many briefs about the number of missiles that the Chinese are going to throw against aircraft carriers and cruisers and what have you. And they are going to build as many as—maybe one aircraft carrier, they might be able to build, I don't know, 5,000 missiles. I am just looking at it from the CPA standpoint, and maybe that is—and that is ironic because I am an infantry guy, but in terms of by the time you get there and the changes in technology, I don't know if we can do that, predict the future.

I am still upset that we cut back on the F–22s. I thought it was a great airplane. I think everybody is going back: Oh, we shouldn't have done that. Well, we did that. It was a mistake. Can you tell me why, when the F–4 Phantom came out, we said, "Oh, we don't need any machine guns on that plane"? This was going to be missile to missile; this is the new warfare. This is talking to a ground guy in Vietnam that was probably saved because they modified that airplane before some of you were born—let me correct that, before most of you in this room were born. But that was a failure to anticipate what was going on with the Air Force.

I am a big, big supporter of airpower and what you have to do. I just have—I don't know if we can predict the future. I would hope that we could have modified the B–1 and the B–2. It scares me when you said we only are going to have 12 flights of B–2s—God almighty—with all of the missiles of the Chinese. Aren't the Russians still flying turbo prop [propeller] bombers around scaring everybody when they come down the English Channel, or maybe that is—but how old is that aircraft? It is not at as old as me, but close. And I am saying they modified that, just like the Chinese, one of the figures I heard was—what?—their budget was 300 percent in the last—increase—in the last 10 years. So I think when we are talking about some of these programs. And as I said, I have been around this planet for a long while. I have seen the F–4, and

I have seen that plant on the Connecticut River in the ranking member's district where they spent, I don't know how much money, Pratt & Whitney, to develop a nuclear energy—excuse me, a nuclear engine for an airframe. I won't tell you how many years and how much money that went in. You can tell where that went.

So I have some serious reservations about this. I think we have got to get it right. And I just hope because the more you stick on there and everything else, it gets so expensive that it's going to fail the budgetary wars. And everybody is going to come down and say, what are we going to cut? And I still want more C–17s, I want more lift for marines who have got to go across the Pacific. We can't do it, but you definitely got my attention when you said we are going to go have 12 sorties of B–2s. We have a real problem.

I am going to support it. I just want to make sure we do it right, and I am going to—I notice your name, sir, is very, very close to how I feel right now. And maybe I am the gunslinger here. And you probably have heard something comparable. I don't have a question. I think what you are doing—but we have got to get this right.

The other thing is we don't have 5 years, 10 years, 20 years, because this is a very, very, dangerous—and I wish we could do it just like that. If it was World War II, how long did it take to get the B–29 on line? When we had planes flying around at Pearl Harbor day, the B–18—anyone ever seen that? Whatever happened to B–36, the B–47, the B–58 Hustler? I could go on and on, and I was a marine, but I read a few Air Force books. So thank you very much for your presentation. Sorry I vocalized so much.

Mr. FORBES. And Paul finishes that with, isn't that true? That is his question.

Mr. Knight is recognized for 5 minutes.

Mr. KNIGHT. Thank you, Mr. Chairman.

Boy, I love the colonel. He brings up a lot of good points, though, he does. In the 1950s, we built the Sentry series in about 5 years, put F–100s in the air, put F–106s in the air in about a 5- or 6-year period. And I bring this up all the time, that building something today with today's knowledge and then thinking 30 years from now might not be the way we should do this. What we might want to do is look back at the 1950s, look back at the 1960s, when we were building multiple aircrafts over a shorter time period. If we are going to build something today and fly the wings off it—we are going to fly the F–35 for 50 years. There is no doubt in my mind that we are going to do that. We are building a bomber right now that we are projecting probably for a 40- or 50-year timeframe. And then probably in 20 years from now, we will start talking about a new bomber.

So I might ask that we think about a new strategy of not flying the wings off and of not buying 100, and then when we need them or when they are down—and I have Edwards Air Force Base in my district. I get to watch the B–2 all the time because there is always one or two of them over there. That means if we have 20 of them and 2 of them are at the test facility, those are not 2 that are capable of going out. And we have to refurbish, and we have to go through the whole process. I have seen this, and I understand that we have learned a whole lot from the B–2 to what we are going

to do with a Long-Range Strike Bomber with stealth technology, with the reapplication of the skin, with all these types of technology.

But I would just ask if this is the proper—I will support this as long as we keep the price down and it accomplishes the mission. But is this the proper stance that America should look at? Or maybe should we look at two or three aircraft in a 50-year timeframe, where they overlap, and we are not looking at a 10- or 12-year time period of when we are thinking about it, when we are building it, and when we are testing it, and then it goes IOC [initial operating capability], because this aircraft will not be in the air for that young captain to fly until about 2025? That means today, until then, we have the B–52, the Bone [B–1], and the B–2. So that is my question.

General ELDER. Congressman Knight, your point is actually accurate, and I believe, I'm not read in on the program, but based on everything I have heard about the program and the public testimony that—why I keep referring back to this open mission systems and the open architecture. It is a physics problem basically to design a stealth platform in terms of plan, form, and the basic shape that actually makes it stealthy. There are other things you can add to it that make it stealthier, but in terms of adding the capabilities to the platform, in the past, the problem that we had was that if you were going to try to change these things, you had to break into the airplane basically to do it. What they realized after the work, particularly with the B–2, was that they needed to have a way that they could make substantial capability improvements to the airplane, whether that was a weapon system. You have to remember so much of this is involved with the code, but it also has to do with communications. If you need to put a new aperture, as they call it, a new antenna, an aperture on the plane, it would require this major amount of testing. They don't have the problem with the LRS–B, and they have already demonstrated—all three of the vendors involved with this have demonstrated their ability to comply with these open mission standards, and they have various different tests that show that they can make this work. So, in effect, they are actually doing what you have suggested because the airplane that is built in 2025 will be different than the one that is built in 2030 in terms of capabilities it has, but the neat thing is that they will be able to take the one that was built in 2025 and bring it up to that 2030 capability, because they can put the same software and because of the way it has been designed in the first place.

Mr. KNIGHT. General, I am not going to cut you off, but I am going to grab some time here. I understand that, and software is what F–35, F–22, to much of the extent F–16 and F–15 do today. You cannot change the structure of an aircraft. So if I built the structure of an aircraft today, that will be the structure that I have in 2050. That will be it. So if something changes in that time period, that they can see our bombers quicker or they can address our bombers quicker, because of the structure, I am stuck, I am done. I might be able to do some sort of software, I might be able to do some sort of jamming upgrades, but if something happens in the next 40 years that stops me from doing that because of the structure, I am stuck.

Mr. GUNZINGER. Very quickly, sir, you are right. It is very difficult to change the plan, form, shape, and size of an aircraft after it has been designed and produced. You can do things like give it new codings. You can put maybe new leading edge treatments on it, things that can improve its stealth characteristics. You might also be able to do some things to give it active as well as passive measures to improve its ability to survive. But like we all understand, I believe, stealth is the product of active and passive measures, and not just one aircraft but multiple platforms operating together to include cyber operations to create the environment where you defeat the enemy's kill chain, the air defense kill chain. And it does not remain invisible, but all you have to do is prevent him from getting a good shot.

Mr. KNIGHT. I appreciate that, and I appreciate the chair letting me go over just a little bit. I understand that, and I will be highly supportive of this, again, if we can stay within the budget and within the parameters we have set forth. I just think that this should be a discussion that we move forward with in the future, that we talk about these programs that overlap more than talking about a program that—now the B–2 is 25 years old. I was there at the rollout, and I was there at the 25th anniversary. It is still our top bomber with 10 or 15 years from where we are going to get to the next bomber. Thank you.

Thank you, Mr. Chair.

Mr. FORBES. Well, we want to thank our witnesses for being here today. As we mentioned at the outset to each of you, we would love to give you some time to do a wrap-up of what you think we need to have on the record for this program. So we are going to give you that time now if you need it. And any clarifications for anything on the record or any additions, we would love to hear from you at this time.

General, we will once again start of off with you, and we will finish with Dr. Grant.

General ELDER. Well, Mr. Chairman, and the committee, again, I really do appreciate the opportunity to be here. This platform, I am not read in on this platform. I was very familiar with the airplane that was going to be built in 2018, and they made a conscious decision at that time that they were going to lock in the requirements and they were going to work with technologies that were well known, well developed. When I was still on Active Duty, I remember I had some great ideas myself. I said that this would be a great thing to have on this new airplane, and they said: We will put it into the mix for a possible adaptation down the road, but it is not a proper TRL [technology readiness level] level or the level of sophistication that we are willing to consider because we only want to bring things into this platform that we know will work when we integrate them together.

But at the same time, they said: Don't worry because we are building this airplane so that these new capabilities can be added later on. We have gone to great efforts to make sure they do that, and they have had programs to continue to do that.

As Dr. Grant pointed out, the teams that developed the 2018 bomber, the Department of Defense right away provided money to keep those teams working, so as they put together the new, which

then became the LRS–B, so these teams have been consistent for a long period of time, which is part of the reason that I am very confident that this airplane is going to have the great capabilities that we are attributing to it. And I also believe it is going to have the adaptability and, from talking to people who are involved with the program, who say: I wish I could tell you about the program, I wish I could tell you. It is just absolutely phenomenal what they have done with this program. I have talked to logisticians, who are usually the biggest ones to complain about a program, because they say they forgot about us. And they said: It is phenomenal. They thought about us. They thought about how to maintain it. There has been a big push to keep high emission-capable rates, which means that you have to make it easy to maintain. All these things have been worked in.

So while I haven't been read into the program, the people I know that are very familiar with this—and I guarantee would have no qualms at all to complain to me if they thought there was an issue—are just ecstatic about this. I have always liked to think of myself, I grew up in Strategic Air Command, and I was someone who thought a lot about deterrents. And with the fall of the Berlin Wall, there was a lot of people who thought we did not need to think about deterrence anymore because we didn't have a Soviet Union. They were right that we didn't need to worry about the Soviet Union anymore, but they were wrong to think that we didn't need to worry about someone else coming and finding some way to attack us. And we have had these various different ways. We have grown much more sophisticated in terms of our understanding of how to use military force in concert with other instruments of national power to be effective, and we have seen not only bombers but all of our military force.

But I will try to highlight the bombers, how they have been used in Bosnia, in Kosovo, in Afghanistan, in Libya, in Iraq, to be able to do things that we typically don't think about the airplanes doing. And, again, this goes to those great captains who say: Hey, you know, I know what we can do this with airplane. And then you have some great strategic leaders or operational leaders who say: Boy, now that you have showed me we could do that, we can work this thing in, and we can make it effective.

The LRS–B provides a platform. It is kind of like, I like to use—You buy an iPhone or you buy an Android—it doesn't matter—and it gives you capabilities to bring all these different apps that you can put on. And as Mr. Gunzinger was pointing out, these apps—there are a lot of apps. They can be electronic warfare apps. They can be ISR apps. They can be bombing apps. They might be cyber apps. All these things are possible because this particular platform was designed not only to be something that is easily adaptable, but it also was designed to be part of a family of systems. So this ability to interoperate with maritime forces, with ground forces, with space forces, it really is an important aspect of this.

And whereas the B–2 was largely developed, initially at least, that it would try to go in alone and unafraid and that is why you weren't going to see it because there wasn't much around. This time they are recognizing you are going to want to use this platform in cases where people are looking for you, so you are just

going to make it really difficult for them to pick you out. And because the plan form of this thing, that is the physics of it, it makes it very difficult for acquisition and particularly for the radars that are actually used to target, to be able to hit, but it is bringing in all of the different types of stealth. It is stealth across the entire electromagnetic spectrum to make this thing very hard to go through as, Mr. Gunzinger, the kill chain. You can't—not just enough to see it, to actually put a weapon against, it is going to be very difficult. And I believe from the people that I have talked to, although I can't personally witness to because I haven't seen it, but I believe that the Nation is going to be very impressed when they see this airplane. And I believe that the Department is going to be able to use this platform in conjunction with the Navy, the Army, and the Marine Corps to do some very good things for national security for the Nation.

Mr. FORBES. Thank you, General.

Mr. Gunzinger.

Mr. GUNZINGER. Yes, very quickly. We did essentially end up with a silver bullet force in the B–2s in the 1990s, and pretty much the F–22s, I would have continued production of that as well. Because we devalued stealth, the air defense strike wasn't there, but today it is. And it is just going to be increasing in the future, and these technologies are proliferating, so stealth increasingly is going to be the price of admission into future fights.

The second is long range and large payloads. Aircraft that can fly from more distant airfields out of the immediate threat of the short- and medium-range ballistic missiles and cruise missiles is going to be very important to us. That might reshape the kind of force we want in the future.

The third, we have said it has been about 10 years since the 2006 QDR. It is going to be about another 10 years for LRS–Bs to show up in numbers. That period could be longer. We focused on, should it be 80 to 100 or something more? And I agree with my fellow witnesses that, yes, I think the number is eventually going to be much larger than that, but that is a 2020s decision. Of more importance to me is, how quickly can we field this force? And if the yearly procurement rate is set pretty low due to budget problems, budget caps, budget constraints, then it is just going to extend into the future our long-range penetrating strike capability gap. So that is something that you might focus on as well. Thank you.

Mr. FORBES. Dr. Grant, we are going to let you have the last word.

Dr. GRANT. It comes down to two things: First, your excellent question. What happens if we don't get a new bomber? If we don't get a new bomber, our adversaries will hide and keep in sanctuary hostile military capabilities, like anti-satellite weapons, like potential weapons of mass destruction. And these capabilities will threaten our national security and the world we live in, and we won't be able to do anything about it.

Second question, should we buy this bomber, the one that is coming to down select? And I say yes. I think this is the one. But from what the Air Force has said, they have conducted more risk reduction. They have taken a new approach, and they have built on tre-

mendous technologies from other programs. This is the one to buy. We can't afford the risk of waiting. Thank you very much.

Mr. FORBES. We want to thank all three of you for being here. We give you, as I told you before, an open invitation as you see this process. What Mr. Cook raised, what Mr. Knight raised, great questions. We actually posed some of these to them before this hearing because these are important things to do.

Mr. Courtney and I recently were at some briefings, and I think we were both informed and both concluded that probably cutting that F–22 production line was one of the worst mistakes we made for national defense in some time. So we need to get these things correct and make sure that we are able to produce them.

But we thank you for giving us your expertise, your wisdom, and your knowledge on this. If no one has anything else, then we are adjourned.

[Whereupon, at 3:10 p.m., the subcommittee was adjourned.]

A P P E N D I X

SEPTEMBER 9, 2015

PREPARED STATEMENTS SUBMITTED FOR THE RECORD

SEPTEMBER 9, 2015

WITNESS STATEMENT
Sea Power and Projection Forces Subcommittee
House Armed Services Committee

Lt Gen (Ret) Robert Elder, Engr.D
Research Professor, George Mason University
September 9, 2015

Mr. Chairman and members of the committee, it is a privilege to have been offered this opportunity to talk with you today about the value of long-range strike bombers to US national security.

US bomber capabilities are withering. Today, the US has fewer than 100 combat ready bombers with an average age of 38 years and not even 20 of those (the newer B-2s) can penetrate enemy airspace and deliver the necessary firepower joint commanders need. The older bombers are simply not survivable in the face of modern air defenses. The newer B-2s remain potent, but are few in number. And while the Air Force is planning to build a new bomber, the Long-Range Strike Bomber (LRS-B), the 80-100 aircraft number being discussed is simply not enough.

The LRS-B is truly a national security bargain when one considers the range of missions this one platform will provide. Unlike most military systems, which are designed to provide utility for a small number of missions, bombers provide value in times of peace, crisis, and conflict. And bombers have demonstrated their ability to remain viable for long periods of time. They are inherently adaptable. Other platforms can perform similar missions. However, it takes many different platforms combined to cover the full gamut of bomber capabilities. Long-range strike bombers serve as a global strike and sensor platform which are distinctively capable of providing a range of effects against dynamic targets anywhere on the globe using their own organic queuing. They also serve as a powerful tool for diplomacy. Let me briefly highlight the range of missions bombers perform.

First, there is strategic (nuclear) stability: In addition to traditional nuclear deterrence and assurance, long-range bombers provide the president a range of conventional and nuclear options, offering both decision time and space that are critical for crisis stability and escalation control in situations involving other nuclear actors. This capability is unique to long-range bombers. A Rand Corporation analysis found that long-range bombers are more effective than short-range fighters or missiles for stabilizing a crisis and managing escalation. Bombers also reduce the impact of a nuclear competitor developing a revolutionary capability to counter the effectiveness of US ballistic missiles.

Bombers play several critically important arms control roles: they provide a valuable hedge against a possible nuclear arms treaty weapon breakout, an adverse geopolitical shift affecting

the balance of nuclear forces between the United States and its nuclear competitors, or a catastrophic technical failure in another leg of the Triad.

Closely related to strategic nuclear stability, bombers also provide global stability, that is, the ability to influence situations around the globe operating from garrison bases. Such actions include providing a show of force or a demonstration of commitment to an ally or friend. All deployable military forces can operate globally, but bombers are unique in their ability to provide conventional global effects without first deploying. Stealth bombers are not only used in conflict against the most valuable and most defended targets, but they can also be used to prevent conflict. It was just about two years ago that the North Korean regime was rattling its sabers, threatening both our allies in the region and Hawaii with long-range missile attacks. The US needed to send North Korea a very clear message but the options were limited. The message: We can reach out and strike you from anywhere in the world … and we can do it quickly.

Two B-2 stealth bombers were called in. These aircraft flew 6,500 miles from Whiteman Air Force Base in Missouri, dropped bombs on a test range in South Korea, performed a low approach at one of the bases in the ROK and flew back to the US. The weapon in this case, a photograph, sent a message--a strategic message--which the US published in the media at the time of the flight: "The United States is steadfast in its alliance commitment to the defense of the Republic of Korea, to deterring aggression, and to ensuring peace and stability in the region. The B-2 bomber is an important element of America's enduring and robust extended deterrence capability in the Asia-Pacific region." In short, the stealthy B-2 not only fights wars, it also stabilizes dangerous situations.

Flying the two bombers to South Korea was also a reminder to the Chinese that North Korean actions have consequences. By operating from the sanctuary of the US homeland, the US was able to quietly signal that we were taking North Korea's threats seriously, but escalation was not necessary. The two bombers were capable of carrying a total of 160 individually targeted, GPS-guided weapons, a strong signal that war with the United States would not end well.

Finally, bombers provide regional stability, long considered a primary mission for sea power forces. Long-range bombers and maritime forces complement each other exceptionally well in conducting this important mission. Long-range bombers provide combatant commanders a range of conventional and nuclear options operating from regional or CONUS bases, and can be readily integrated with other United States and partner capabilities to influence the decision calculus of regional actors. It is worth noting that bombers today provide the primary extended nuclear deterrence capability in the Pacific.

The regional stability mission requires additional discussion. Although this committee is well aware, few others know that a rotational force of bombers have been deployed to Guam since March 2004 providing continual bomber presence to support stability in the region. The bombers and supporting forces were initially deployed because the Pacific carrier strike group was re-tasked to support Operation Iraqi Freedom. Since this committee understands well the

strains of maintaining rotational forces, it is important to recognize that the Nation needs to procure bombers to not only replace the aging B-1 and B-52 fleets, but also to provide additional force structure to round out the U.S. Air Force expeditionary capability. There is currently not enough bomber structure to meet today's combatant commanders' needs. 100 bombers should be considered the minimum initial procurement quantity. Substantially more aircraft will be needed to replace both the B-1 (63 aircraft) and B-52 (76 aircraft) fleets and meet the demands of the combatant commanders for bomber forces in support of their operations. This also means that the current fleets must continue to be modernized even as the LRS-B is brought into the Air Force inventory.

Bombers also play an important role in providing combatant commanders the foundation for operational campaign alternatives where US air forces, often in partnership with coalition air forces, empower indigenous ground forces to defeat otherwise more powerful adversaries. In examples such as Bosnia, Afghanistan, and Libya, stealth and standoff munitions proved critical to the success of these operations, and were used extensively until the adversary defenses were degraded, and other forces could be used safely and effectively.

The importance of bombers for joint theater operations such as interdiction and theater strike is well known, but improvements in technology have made them invaluable as close air support platforms. Bombers have provided other direct support to ground commanders by employing their sensors for surveillance and reconnaissance purposes. Its payload and persistence makes it uniquely effective for a broad range of theater operations.

Bombers also support the homeland defense mission: They keep combat abroad, far from U.S. territory. They also leverage their long range and onboard sensors to support the U.S. Navy and U.S. Coast Guard in the conduct of maritime surveillance off our coastlines, and they have demonstrated their ability to effectively engage maritime targets.

Bombers additionally provide the President and other senior national leaders the foundation for a range of strategic alternatives by facilitating the use of national partner instruments of power to achieve national objectives. A very good recent example can be found with the Kosovo operations where airpower was used to convince Mr. Milosevic to negotiate an end to Serbian operations against the Albanians in Kosovo. Once again, stealth aircraft and standoff weapons were critical to the conduct of the initial operations and were employed until the adversary defenses were sufficiently degraded for other aircraft to operate effectively.

Finally, the long range strike bomber will play an important role in denying competitor strategies; in particular, operating as the foundation for a family of global strike systems, the LRS-B will impose substantial cost on adversaries attempting to contest US access or deny our ability to conduct expeditionary operations in support of friends and allies. Manned platforms will provide flexibility and resiliency, particularly in contested spectrum and information environments. Stealth degrades and disrupts the effectiveness of anti-access, area denial (A2/AD) strategies; standoff and electronic warfare capabilities complement stealth by complicating adversary defenses.

Use of open architectures and open mission systems will allow the long-range strike bomber to incorporate new technologies and adapt easily to evolving changes in the threat environment. Also noteworthy, Air Force operators have repeatedly found ways throughout history to employ their systems in ways their designers never imagined. The Nation can expect similar examples of innovation and ingenuity once the LRS-B is fielded.

Study after study has shown that bombers do more than simply strike targets. Bombers offer structural stability for both conventional and nuclear scenarios, provide the most flexible component of the US strategic Triad and are the best way to reassure allies of our commitment to extended deterrence. In other words, the bomber is more than just a strike and sensor platform; it is also a powerful tool of diplomacy. Long-range stealth strike capabilities provide the Nation practical alternatives for global security and regional stability, and provide combatant commanders increased effectiveness in the conduct of joint operations across the full range of conflict. They are absolutely critical for our national security, and because of their versatility, provide the Nation exceptional value.

Lt Gen Robert Elder, USAF (Retired)
Research Professor, George Mason University

Lieutenant General Robert Elder (USAF, retired) joined the George Mason University faculty as a research professor with the Volgenau School of Engineering following his retirement from the Air Force as the Commander of 8th Air Force and U.S. Strategic Command's Global Strike Component. He currently conducts research in the areas of integrated command and control, operational resiliency in degraded environments, strategic deterrence, and the use of modeling to support national security decision-making. General Elder served as the Central Command Air Forces Deputy Commander for Operation Enduring Freedom and later as the Air Operations Center Commander and Deputy Air Component Commander for Operation Iraqi Freedom. He was the first commander of Air Force Network Operations and led the development of the cyberspace mission for the Air Force. General Elder also served as Commandant of the Air War College, and holds a doctorate in engineering from the University of Detroit.

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COMMITTEE ON ARMED SERVICES
U.S. HOUSE OF REPRESENTATIVES

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Federal grant/ contract	Federal agency	Dollar value	Subject of contract or grant
n/a			

2014

Federal grant/ contract	Federal agency	Dollar value	Subject of contract or grant
n/a			

2013

Federal grant/ contract	Federal agency	Dollar value	Subject of contract or grant
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2015

Foreign contract/ payment	Foreign government	Dollar value	Subject of contract or payment
n/a			

2014

Foreign contract/ payment	Foreign government	Dollar value	Subject of contract or payment
n/a			

2013

Foreign contract/ payment	Foreign government	Dollar value	Subject of contract or payment
n/a			

September 9, 2015

STATEMENT BEFORE THE HOUSE ARMED SERVICES SUBCOMMITTEE ON SEAPOWER AND PROJECTION FORCES ON THE FUTURE OF AIR FORCE LONG-RANGE STRIKE

By Mark Gunzinger
Senior Fellow, Center for Strategic and Budgetary Assessments

Chairman Forbes, Ranking Member Courtney, and Members of the Sub-Committee, thank you for the opportunity to present a few thoughts on the future of Air Force long-range strike.

In my testimony, I will suggest a framework for thinking about future long-range strike operational concepts and capability priorities. This framework focuses on two competitions between the U.S. military and its potential adversaries. The first is the "hiders versus finders" competition, which I will use to describe the evolution of capabilities that enable aircraft to "hide" as they penetrate contested areas and the development of defensive systems to "find" penetrating aircraft.[1] The second is the precision strike "salvo competition" which occurs between enemies that are each prepared to conduct high-volume offensive strikes as well as defend against their opponent's precision strikes. Significant changes in both competitions are driving a need for the U.S. military to change its operational concepts and precision strike capability priorities.

I will conclude by addressing several factors that could impact the timely fielding of the Long-Range Strike Bomber (LRS-B) and other new capabilities that are needed to maintain our military's advantage in these competitions.

Maintaining an advantage in the hider-finder competition

The hider-finder competition covers the whole range of capabilities needed to detect, track, and target military forces on the one hand, as well as capabilities to hide, conceal, obscure, deceive, or blind forces on the other. This competition is most pronounced in contested and denied areas where U.S. air forces face a growing array of precision air defense systems.

Two points provide important context for this discussion. First, it is erroneous to think that maintaining the bomber force's ability to penetrate contested areas will require the Air Force to develop aircraft that cannot be detected by enemy air defense systems. "Stealthy" aircraft are not *invisible* to enemy defenses. Rather, stealth results from a combination of exquisite mission planning, operational security, and passive and active measures that prevent defenders from

[1] For an explanation of the hiders versus finders competition, see Michael G. Vickers and Robert C. Martinage, *The Revolution In War* (Washington, DC: Center for Strategic and Budgetary Assessments, December 2004), pp. 109–114. "Penetrating platforms" also includes munitions such as standoff cruise and ballistic missiles that are launched into contested areas.

obtaining sufficient information on a penetrating aircraft's location, altitude, range, airspeed, and flight path to prosecute a successful intercept. Second, similar to other military competitions, the hider-finder competition should be seen as a move-countermove cycle, where advantages gained by competitors are temporary and eventually offset by countermeasures. For instance, the fielding of radar systems capable of detecting aircraft helped motivate the development of countermeasures such as aircraft-dispensed metallic chaff, radar jammers, and stealth technologies.

Broadly speaking, two Cold War cycles of the hider-finder competition influenced development of the Air Force's current bomber force. I'll start with the B-52—an aircraft I used to fly. The Air Force began development of the B-52 in the late 1940s, when the main air defense threats were radar-guided anti-aircraft artillery and fighter-interceptors. Thus, the bomber was designed to fly at high altitudes to avoid ground fires, and it was provisioned with tailguns to defend against Soviet fighter-interceptors. In the late 1950s, improving air defense radars and fighters led the Air Force to begin developing a new bomber, the B-70, capable of flying three times the speed of sound at altitudes thousands of feet higher than the B-52's operational ceiling.

In the late 1950s and early 1960s, the Soviet Union took advantage of emerging missile and guidance technologies to field surface-to-air missiles (SAMs) that could reach aircraft at high altitudes. In light of this threat and the growing sophistication of Soviet fighter-interceptors, the Air Force cancelled the B-70 and modified its B-52s to operate at low altitudes.[2] Flying at low altitudes helped penetrating bombers to avoid SAMs by taking advantage of terrain masking and ground clutter, or "noise" created by ground features, which greatly reduced the effectiveness of enemy fighter radars. The Air Force's B-1 bomber, originally intended to replace the B-52, was designed to penetrate Soviet airspace at low altitudes and sprint at high speeds to reduce the amount of time it would be exposed to air defense threats.

The next cycle in the hider-finder competition began before the B-1 entered the Air Force's active inventory. In the late 1970s, DoD determined the Soviet Union was developing "look-down/shoot-down" radars and missiles that would allow its fighter aircraft to attack U.S. bombers flying at low altitudes. The proliferation of man-portable air defense systems (MANPADS) with infrared sensors also increased the lethality of the low altitude operational environment. These threats added impetus to the Carter administration's creation of an Advanced Technology Bomber (ATB) program to develop a stealth bomber that would replace increasingly vulnerable B-52s. The ATB program evolved into a program to procure 132 stealthy B-2s for the Air Force. However, the collapse of the Soviet Union combined with DoD's shift in focus toward defeating regional aggressors, who during the 1990s lacked sophisticated air defenses, led to a decision to truncate the procurement of B-2s far short of its original acquisition target.

[2] The B-70 was not suitable for high-speed, low-altitude flight.

Instead of replacing aging B-52s with a stealthy penetrator, B-2 procurement was cut to 75 aircraft in 1990 and finally capped at 21 aircraft in 1997.[3]

The B-2 program's reduction marked the beginning of a multi-decade break in DoD's procurement of long-range, penetrating strike aircraft. While the Pentagon continued to pursue technologies that could be incorporated into future stealth platforms, it deferred funding for a new penetrating bomber in favor of upgrading its existing bombers. It also shifted toward using short-range fighter aircraft as the predominant means of delivering weapons on targets. This shift was partly based on the assumption that U.S. fighter forces would be able to operate with near impunity from regional airbases that were located close to an enemy's territory. The 1997 QDR report asserted that DoD did not require more than 21 B-2s because the bombers would not "provide the same weapons delivery capacity per day as the forces [mostly fighters] that would have to be retired to pay for B-2s," and the advantages that bombers offered early in conflicts with enemies invading a U.S. partner state diminished as U.S. land- and sea-based fighters arrived in theater.[4]

As a result, the Air Force's bomber force is now the smallest and oldest that it has ever operated (see Table 1).

TABLE 1. 2015 AIR FORCE BOMBER FORCE

	Total Aircraft Inventory	Primary Mission Aircraft Inventory	Average Age (Years)
B-52H	77	54	54
B-1B	62	41	28
B-2	20	19	21
Total	159	114	39

Unfortunately, America's potential enemies did not pause in their efforts to develop more capable surveillance systems and air defenses; the hider-finder competition continued. China, Russia, Iran, North Korea, and others now have sensors and precision-guided defensive weapons that are capable against non-stealthy B-52s and B-1s. With the exception of 19 primary mission B-2s, the Air Force's long-range strike force is limited to operating in low- to medium-threat environments. If required to operate from bases that are 1,500 or more miles from target areas, this small B-2 force would generate only ten to twelve strike sorties per day.[5]

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[3] DoD's decision to cap B-2 procurement was supported by its Deep Attack Weapons Mix Study (DAWMS), which was part of the 1997 Quadrennial Defense Review (QDR). This author participated in DAWMS.

[4] Department of Defense (DoD), *Report of the Quadrennial Defense Review* (Washington, DC: DoD, 1997), Section 7, available at http://www.dod.mil/pubs/qdr/sec7.html.

[5] For instance, it is about 2,700 nautical miles (nm) line-of-sight from Diego Garcia in the Indian Ocean to Natanz, Iran, and over 2,100 nm from Guam in the Western Pacific to the interior of China.

The good news is the development of new stealth capabilities including the LRS-B, F-35, and cruise missiles indicates DoD has reengaged in the hider-finder competition. However, while initial procurement of the F-35 is underway, it has been about ten years since DoD's 2006 Quadrennial Defense Review (QDR) directed the Air Force to develop "a new land-based, penetrating long-range strike capability," and it will be another ten years before LRS-Bs begin to join the force in significant numbers.[6] At least six years of this delay can be attributed to Secretary of Defense Robert Gates' 2009 decision to cancel the precursor to the LRS-B, the so-called Next Generation Bomber. Further delays in procuring the LRS-B or low LRS-B production rates that are driven by budget cuts would worsen America's long-range, penetrating strike capability gap.

Maintaining an advantage in the precision strike salvo competition

A salvo competition can be described as the dynamic where combatants seek to gain advantages by improving their ability to attack with precision and defend against enemy strikes.[7] The U.S. military's ability to conduct sustained, large-scale precision strike operations has been unmatched by the enemies it has fought since the end of the Cold War. Today, however, the proliferation of precision guidance systems and other weapons technologies have enabled potential enemies to create their own inventories of PGMs, including guided missiles capable of striking U.S. airbases located across the Western Pacific and Middle East. In future salvo competitions, continuing to rely almost exclusively on close-in regional airbases that are within range of an enemy's air and missile forces could greatly reduce the tempo of U.S. military strike campaigns.

There are alternatives that could help maintain America's precision strike advantage. For instance, DoD could adopt new concepts for conducting "distributed" operations from networks of highly dispersed close-in bases, including civilian and improvised airfields. It could also shift most of its strike aircraft to bases that are located out of range of most air and missile threats. While both concepts would complicate an opponent's targeting problem, operating U.S. strike aircraft further from the battlespace would also force an enemy to use longer-range, more expensive guided missiles to attack U.S. airfields.

It is important to consider that the opposite is also true: the size of U.S. precision strikes are sensitive to the ranges over which they are launched. While using more distant airbases could decrease the risk of enemy attacks, the need to fly longer distances to target areas would also reduce the number of sorties U.S. air forces could generate each day. For instance, operating from airbases on Guam and Diego Garcia would require U.S. strike aircraft to fly thousands of

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[6] Department of Defense, *Quadrennial Defense Review Report* (Washington, DC: DoD, February 2006), p. 46.

[7] This dynamic is different than that of previous salvo competitions, such as between French and British warships in the 19th century, or Allied and German naval forces in World War I. In those early competitions, combatants did not have capabilities to intercept each other's salvos.

miles to attack targets on the Asian mainland. This would reduce their daily sortie rates and the number of PGMs they could deliver. The Government Accountability Office determined B-52s flew an average of 0.6 sorties per day during Operation Desert Storm primarily because they operated from "far more distant bases" than fighters, which included the joint-use base on Diego Garcia.[8]

This suggests it would be inefficient to use fighter aircraft with about one-fifth the unrefueled range and one-tenth the payload of a bomber to routinely conduct strike missions from distant airfields. Alternatively, it would be more feasible to frequently move fighters (rather than bombers) in shell-game fashion around a distributed network of close-in temporary and permanent airfields to complicate the enemy's targeting problem. In other words, the relationship between range, sortie rates, payload size, and emerging threats makes a compelling case for using bombers staged from distant airfields for the bulk of the U.S. military's airstrikes in future salvo competitions. In lieu of using fighters for long-range strikes, U.S. fighter forces could operate from a network of close-in, highly distributed bases to counter threats to penetrating bombers.

Some implications for the future long-range strike force

Several major insights can be drawn from assessments of the hider-finder and salvo competitions. Perhaps the most important is that the time has come for DoD to flip the prioritization of fighter and bomber forces it adopted in the immediate aftermath of the Cold War. The primacy of fighters over bombers was reasonable in the 1990s when air operations could largely be conducted from close-in regional bases in relatively permissive environments to quickly establish air superiority and attack targets nearly at will. But considering changes to the operational environment, those days are long over.

According to DoD's own planning documents, U.S. combat air forces may have to stage their initial operations from distant bases that are less susceptible to missile attacks, and then penetrate areas that are defended by a new generation of SAMs, fighters, and other sophisticated threats. The most advanced SAMs in the world are no longer in the hands of only one or two countries like Russia and China, but are rapidly proliferating in regions such as the Middle East.

These and other threats are cratering America's preferred way of war. This necessitates a fundamental rethinking of how the U.S. military should conduct power-projection operations and the mix of capabilities it will need in the future. DoD is taking initial steps toward developing a family-of-systems that will sustain America's long-range strike strategic advantage. Unlike the B-2, the foundation of this family-of-systems—a new stealth bomber—will be needed in

[8] Government Accountability Office (GAO), *Operation Desert Storm Evaluation of the Air Campaign* (Washington, DC: GAO, June 1997), p. 170.

quantity.[9] Instead of a niche capability, stealth, coupled with long ranges and large payloads payload—will be the price of admission into the fight for operations against enemies equipped with anti-access and area-denial (A2/AD) capabilities.

Managing growth in the cost and time needed to field new LRS family-of-systems capabilities

Members of this Subcommittee understand that prolonging the development of new weapon systems combined with excessive requirement changes during their development can increase program cost. According to analyses conducted by RAND and the Institute for Defense Analyses, budgets "can and do change annually without regard for programmatic effect" thereby resulting in "substantial total cost growth, both from stretching the development program, as well as lowering production rates, which increases unit production costs."[10] DoD should guard against program cost growth that can reduce the number of new long-range strike capabilities it can afford to buy. In particular, changing the LRS-B's requirements during development, cutting its planned production, accepting an inefficient production rate, and changing production rates in mid-stream could significantly increase its cost.

Changing requirements. Basing capability requirements on assessments of future needs, rather than current war plans and threats, coupled with disciplined efforts to refrain from adding new requirements can reduce the number of costly change orders needed for a major weapon system. Keeping programs on schedule may also help avoid the problem of early obsolescence for capabilities that take a decade or more to field. The good news is the LRS-B is designed to periodically incorporate upgrades after it is fielded to refresh its technology and address new threats as they emerge. Planning for incremental block upgrades to the LRS-B will also help spread its total cost over time.

Reducing production quantities. Reducing the planned buy of a weapon system in mid-production can also increase its program unit cost, which is the total cost of a program (development plus production) divided by the number of articles procured. Historical data shows that cutting the number of aircraft—military or commercial—procured often leads to significant

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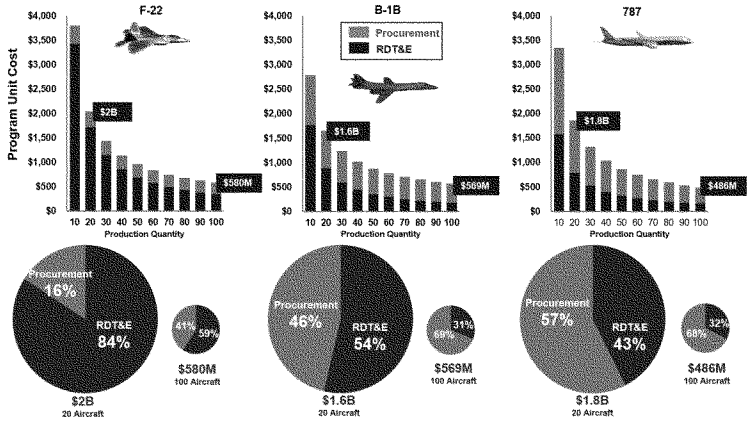
[9] The long-range strike family-of-systems will include the LRS-B and other systems such as a new, penetrating cruise missile and supporting "intelligence, surveillance and reconnaissance (ISR), electronic attack (EA), and command, control and communications (C3) assets." Air Force Global Strike Command (AFGSC), *Strategic Master Plan 2014* (Barksdale AFB, LA: AFGSC, March 1, 2014), p. 10, available at http://www.defenseinnovationmarketplace.mil/resources/AFGS-2014StrategicPlan.pdf.

[10] Obaid Younossi, David E. Stem, Mark A. Lorell, and Frances M. Lussier, *Lessons Learned from the F/A-22 and F/A-18E/F Development Programs* (Santa Monica, CA: RAND, 2005), available at available at http://www.rand.org/content/dam/rand/pubs/monographs/2005/RAND_MG276.pdf; and Gene Porter, Project Leader, *The Major Causes of Cost Growth in Defense Acquisition, Volume II: Main Body* (Alexandria, VA: Institute for Defense Analyses, 2009), p. 54, available at www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA519884.

program unit cost growth.[11] Figure 1 illustrates three theoretical examples of cost growth that could result from production quantity cuts.[12]

FIGURE 1. ILLUSTRATIVE AIRCRAFT PROGRAM UNIT COST GROWTH FOR DIFFERENT PRODUCTION QUANTITIES



Similar to the B-2, a limited purchase of 20 F-22s, B-1Bs, or Boeing 787 Dreamliners would result in unit costs that range between $1.6 billion and $2 billion per copy. In contrast, buying 100 aircraft slashes their cost by 70 percent or more. Much of this reduction is due to the fact that their fixed development costs would be amortized over a larger fleet. In other words, as the production quantity increases, the fleet shoulders the development costs more evenly.

A series of production cuts as well other factors contributed to growth in the F-22's cost (see Figure 2).[13]

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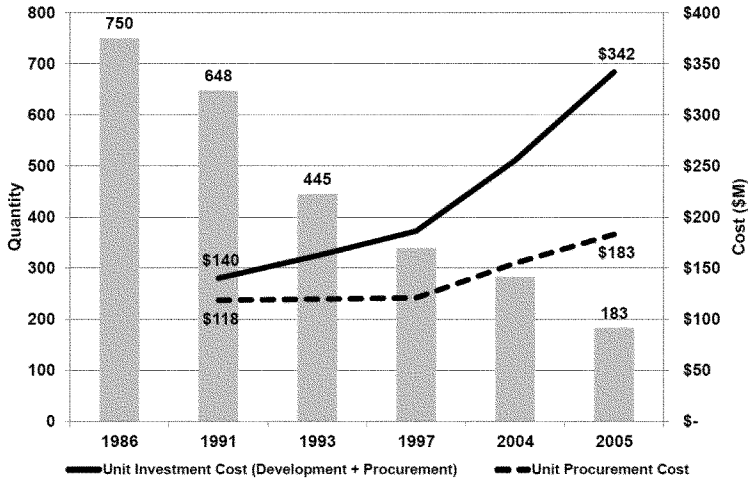
[11] A 2011 independent assessment of DoD's major acquisition programs concluded, "For programs with upfront research and development costs, reducing the number of units lowers the overall program cost but it increases the per-unit cost, effectively curtailing the government's buying power." Joachim Hofbauer, Gregory Sanders, Jesse Ellman, and David Morrow, *Cost and Time Overruns for Major Defense Acquisition Programs* (Washington, DC: Center for Strategic and International Studies, 2011), p. 6, available at http://csis.org/files/publication/110517_DIIG_MDAP_overruns.pdf.

[12] Figure 2 costs are in 2010 dollars. B-1B cost data is from Congressional Budget Office, *Total Quantities and Unit Procurement Cost Tables 1974 to 1995*, April 13, 1994; Susan J. Bodilly, *Case Study of Risk Management in the USAF B-1B Bomber Program*, Santa Monica: RAND Corp., 1993; and the Department of Defense, *B-1 SARS and ATB R&D Cost Estimates*. F-22 cost data is from DoD P-1 and R-1 budget displays for FY1999 to FY2014. B787 cost data is the from Boeing company's website, and Lisa A. Schwartz and Jeremy Busby, *The 787 Dreamliner: Will It Be a Dream or Nightmare for Boeing Co.*, Wingate University, available at http://abeweb.org/proceedings/Proceedings13/Schwartz.pdf.

FIGURE 2. IMPACT OF QUANTITY REDUCTIONS ON F-22 UNIT COST



The relationship between production quantity and unit cost is not unique to aircraft. The history of the Navy's DDG-1000 program shows how major weapon systems that begin with a low planned procurement objective are extremely sensitive to quantity reductions. The Navy initially planned to buy 32 DDG-1000s to provide naval surface fire support from littoral waters.[14] This was reduced to just ten ships when the DDG-1000 entered development, and then capped at three ships. This resulted in a unit price increase of nearly 80 percent, primarily because its development costs were spread over three ships.[15]

Inefficient production rates. Buying major new long-range strike capabilities at economically inefficient *rates* can also increase their unit cost. Stretching acquisition programs subjects them to the effects of inflation, increased labor costs, the inefficient use of manufacturing infrastructure, and slower progress on the production learning curve. While reducing the annual procurement of modern military aircraft may help reduce DoD's near-term outlays, in the long run it can be a Faustian bargain.

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[13] Figure 1 is a slightly modified version of the column chart published in 2006 by the Government Accountability Office. See Government Accountability Office (GAO), *Questions Concerning the F-22A's Business Case* (Washington, DC: July 2006), p. 3, available at http://www.gao.gov/assets/120/114521.pdf.

[14] Ronald O'Rourke, *Navy DDG-51 and DDG-1000 Destroyer Programs: Background and Issues for Congress* (Washington, DC: Congressional Research Service, 2015), p. 30, available at https://www.fas.org/sgp/crs/weapons/RL32109.pdf.

[15] Irv Blickstein et al., *Root Cause Analyses of Nunn-Mccurdy Breaches, Volume 1* (Santa Monica, CA: RAND, 2011), p. 23, available at http://www.rand.org/content/dam/rand/pubs/monographs/2011/RAND_MG1171.1.pdf.

Changing production rates. Changing production rates in midstream can increase or decrease the unit cost of weapon systems. Projected unit costs for military aircraft are tied to specific production rates that are often determined during the early stages of their development. Defense industry uses planned production rates to size their production facilities, procure tooling, and hire and train a work force for a specific program. Production rate cuts driven by factors such as year-by-year fluctuations in funding can result in significant cost growth due to the inefficient use or unplanned expansion or contraction of production lines and work forces. Based on a 1990 Government Accountability Office assessment of the F/A-18, F-16, and F-15 programs, reductions in their procurement rates could significantly increase total program unit costs (see Table 2).[16]

TABLE 2. ILLUSTRATIVE IMPACT ON TOTAL PROGRAM UNIT COSTS DUE TO PROCUREMENT RATE REDUCTIONS

	Example Procurement Rate Cuts	Annual Quantity	Unit Cost (FY2010 $M)
F/A-18	Example baseline	72	25.7
	25% decrease	54	40.0
	50% decrease	36	45.9
F-16	Example baseline	120	36.7
	25% decrease	90	41.2
	50% decrease	60	49.1
F-15	Example baseline	36	48.2
	25% decrease	27	52.0
	50% decrease	18	61.8

In a more recent study of 35 Major Defense Acquisition Programs (MDAPs) including the Air Force's B-1B, C-17A, and F-22 programs, RAND determined that nine percent of their total unit cost growth occurred as a result of decisions to change their development and production schedules.[17]

A planned increase in production rate can have the opposite effect. Another RAND assessment of Air Force and Navy aircraft programs determined that, on average, "A doubling of annual

[16] GAO, *Weapons Production: Impact of Production Rate Changes on Aircraft Unit Costs* (Washington, DC: GAO, December 1990), available at http://www.gao.gov/assets/220/213494.pdf.

[17] Joseph G. Bolten et al., *Sources of Weapon System Cost Growth Analysis of 35 Major Defense Acquisition Programs* (Santa Monica, CA: RAND, 2008), p. xvii, available at http://www.rand.org/content/dam/rand/pubs/monographs/2008/RAND_MG670.pdf. Another RAND study found that the overhead costs for F-22 production were higher than expected because its peak production rate was cut from 48 to 32 per year after its manufacturer had completed an expensive expansion of its production facility. Younossi, Stem, Lorell, and Lussier, *Lessons Learned from the F/A-22 and F/A-18E/F Development* Programs, p. 20.

procurement quantity yields an 11 percent decrease in unit cost."[18] Over the life of a multi-billion dollar acquisition program, fluctuations in unit cost could result in significant savings or major bills.

Conclusion

In summary, the Air Force, in cooperation with the other Services, has an opportunity to create a family-of-systems that will maintain America's long-range strike advantage well into the future. Requirements for this family-of-systems should be based on assessments of future threats and operating concepts, rather than today's operational environment.

In the context of the hider-finder and precision strike salvo competitions, DoD may need to flip the pecking order it established for its fighter and bomber forces after the Cold War. Stealth aircraft should no longer be considered as niche, "knock down the door" capabilities that are best used to suppress air defenses and enable follow-on non-stealthy aircraft to penetrate. Rather, stealth has become an entry-level capability for operations in contested areas. Moreover, the proliferation of missile threats will necessitate operating our combat air forces from bases located farther from an enemy. DoD will need a penetrating bomber force that is large enough and has sufficient range to ensure it is able to deliver high volumes of munitions deep into denied areas.

Developing and fielding substantial numbers of LRS-Bs and other family-of-systems capabilities needed to support this reversal in priorities will be a challenge given defense budgets capped by the Budget Control Act of 2011. Reacting to budget cuts by reducing LRS-B production rates or allowing procurement reductions similar to what occurred to F-22, B-2, and other major programs could balloon the bomber's unit cost and lead to an acquisition death spiral. It could also result in a smaller overall force of penetrating bombers. Either would extend America's long-range strike capability gap and allow future enemies more time to mature capabilities that threaten our ability to project power.

Thank you again for the opportunity to present on this critical capability area.

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[18] Mark V. Arena et al., *Why Has the Cost of Fixed-Wing Aircraft Risen?* (Santa Monica, CA: RAND, 2008), p. 39, available at http://www.rand.org/content/dam/rand/pubs/monographs/2008/RAND_MG696.pdf.

Colonel (retired) Mark Gunzinger
Senior Fellow, Center for Strategic and Budgetary Assessments

Mark Gunzinger is a Senior Fellow at the Center for Strategic and Budgetary Assessments. Mr. Gunzinger has served as the Deputy Assistant Secretary of Defense for Forces Transformation and Resources. He is the principal author or co-author of multiple Defense Planning Guidance directives, key strategic planning documents that shaped DoD's future force planning.

A retired Air Force Colonel and Command Pilot, Mark joined the Office of the Secretary of Defense in 2004. He was appointed to the Senior Executive Service and served as Principal Director of the Department's central staff for the 2006 Quadrennial Defense Review (QDR). Following the QDR, he served as the Director for Defense Transformation, Force Planning and Resources on the National Security Council staff. During his Air Force career, Mark was an aircraft commander/instructor pilot with over 3,000 hours in the B-52, served as a strategic planner on the Air Staff, and helped lead multiple assessments of future capability requirements.

Mr. Gunzinger holds a Master of Science in National Security Strategy degree from the National War College (Distinguished Graduate), a Master of Airpower Art and Science degree from the School of Advanced Air and Space Studies, a Master of Public Administration from Central Michigan University, and a Bachelor of Science in Chemistry from the United States Air Force Academy (Class of 1977). He is the recipient of the Department of Defense Distinguished Civilian Service Medal, the Secretary of Defense Medal for Outstanding Public Service, the Defense Superior Service Medal, and the Legion of Merit Medal.

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Witness name: Mark Gunzinger

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◉ Representative

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Federal Contract or Grant Information: If you or the entity you represent before the Committee on Armed Services has contracts (including subcontracts) or grants (including subgrants) with the federal government, please provide the following information:

2015

Federal grant/ contract	Federal agency	Dollar value	Subject of contract or grant
W91QF0-15-P-0010	Army War College	$55,000	Strategic Choices exercise
HQ0034-14-D-0017	OSD/ONA	$1,105,739	Multiple delivery orders
HQ0034-15-P-0136	WHA-Acquisition Directorate	$72,475	Secretary of Defense Corporate Fellows Program

2014

Federal grant/ contract	Federal agency	Dollar value	Subject of contract or grant
SP4705-10-C-0019	National Defense University	$86,000	Secretary of Defense Corporate Fellows program
N00189-13-F-Z085	Department of the Navy	$120,987	Portfolio Rebalancing Exercise
HR0011-14-C-0112	DARPA	$252,778	System of Systems Transition study
HQ0034-09-D-3007	OSD/ONA	2,136,487	Multiple delivery orders

2013

Federal grant/ contract	Federal agency	Dollar value	Subject of contract or grant
HR0011-13-C-0028	DARPA	$174,939	Battle Network Competitions study
SP4705-10-C-0019	National Defense University	$84,000	Secretary of Defense Corporate Fellows program
HQ0034-09-D-3007	OSD/ONA	$1,200,000	Multiple delivery orders
W91QF0-13-P-0029	Army War College	$62,890	Portfolio Rebalancing Exercise
W91QF0-14-P-0013	Army War College	$57,915	Portfolio Rebalancing Exercise
GS-10F-022AA	National Commission on the Structure of the Air Force	$74,728	Portfolio Rebalancing and Strategic Analysis

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2015

Foreign contract/ payment	Foreign government	Dollar value	Subject of contract or payment
Embassy of Japan	Japan	$110,000	Defense Planning Seminar

2014

Foreign contract/ payment	Foreign government	Dollar value	Subject of contract or payment
Embassy of Japan	Japan	$100,000	Defense Planning Seminar
UAE	UAE	$125,000	Regional Security workshops
Embassy of Japan	Japan	$30,000	Meetings and briefings

2013

Foreign contract/ payment	Foreign government	Dollar value	Subject of contract or payment
Embassy of Japan	Japan	$100,000	Defense Planning Seminar
Embassy of Japan	Japan	$30,000	Meetings and briefings

Dr. Rebecca Grant
Testimony to the Seapower and Projection Forces Subcommittee
House Armed Services Committee
September 9, 2015

Thank you for the opportunity to testify on "The Future of Air Force Long-Range Strike." The Air Force's new Long-Range Strike Bomber is program is vital to our national security. America's power projection forces must be ready to back up our diplomacy and lead our military operations. My remarks address capabilities and employment concepts for the Long-Range Strike Bomber, and conclude with a note on risk reduction and cost.

Capabilities
Today approximately 16 combat-ready B-2 bombers have the reach and survivability to carry out missions deep into heavily defended airspace. The shortage of advanced stealth bombers is a potential weak point in crisis response, conventional deterrence and the nuclear Triad.

Access. The key attribute for the long-range strike bomber is the ability to penetrate close enough to employ a variety of direct-attack precision strike munitions against many types of targets in an adversary's most heavily-defended airspace. The bomber must be prepared to fight through surface-to-air missiles, electronic and information attack, defending aircraft and unmanned vehicles to access this airspace. Targets will include mobile targets and hardened and deeply buried targets

Stealth and Survivability. Stealth remains a fundamental design requirement because it creates a tactical advantage as it degrades radar tracking. Advanced stealth diverts enough of the radar energy to produce a poor return until the attacking aircraft is very close to the observer radar. Techniques for stealth in aircraft design have advanced beyond the B-2 and should be able to address more sectors of the electromagnetic spectrum. The state of the art should allow stealth and electronic warfare to complement each other and enhance bomber survivability. Modern aircraft survivability includes mechanisms to thwart infrared tracking. Information superiority through low probability of intercept battlespace communications also augments survivability.

Range and Payload. Range and payload define a bomber, yet they represent intricate trade-offs. Every bomber from the B-17 to the B-2 had to balance range, payload, altitude ceiling and other factors for maximum tactical advantage. We do not know what parameters the USAF selected this time. However, we can see that the set of choices may have been different from the 1970s decisions on the B-2. The new bomber must have sufficient unrefueled range to carry out its mission after leaving a tanker track. However, this range requirement does not mean it has to fly on its last drop of gasoline. It can be met by a bomber that looks different or even slightly smaller than the current fleet, for example. Current operational concepts have blurred distinctions between global and theater strikes.

Open Software Architecture. The bomber should have an open software architecture to put it at the forefront of battlespace communications from the beginning. This bomber must be able to join the IP-enabled networks which are integral to warfighting concepts. At the same time, the bomber must, like other aircraft, retain capability for redundant command and control if aerial layer or satellite networks are compromised.

Nuclear Capability. The new bomber will become part of the Triad. Aircraft early in low-rate production should have hardware and an appropriate software configuration for the nuclear mission. The USAF should use EMD and initial low-rate production aircraft for flight test and then begin the process of nuclear certification with a small number of bombers in identical configurations.

Upgrade Capacity. The Long-Range Strike Bomber reaching initial capability circa 2025 will fly missions until 2055 and beyond. The bomber must therefore do more than meet minimum requirements. It must have a healthy margin of extra power, capacity for additional weight from new subsystems, and a way to integrate additional apertures for communications, sensors or advanced technologies such as laser self-defense. The bomber's radar and engines may be upgraded over its lifespan and the design should anticipate and pave the way for those additional capabilities. Over time, it may employ directed energy in defensive and offensive systems, and be armed with hypersonic missiles among other weapons. This means planning now for an airframe with space, power, suitable engines, and cooling to allow adaptation. While controlling cost is important, there is no point in cutting corners to buy a bomber that is technology-limited within a decade.

Employment Concepts

The USAF bomber force is the only force in the world capable of carrying out ongoing precision strikes against targets that may gravely jeopardize US national security and the world order. Our bombers stand ready to answer the call to strike hostile missile launch systems, weapons of mass destruction, hardened command and control, systems that threaten the peaceful use of space, and more.

Direct Attack. Direct attack is essential because cruise missiles and other stand-off weapons cannot take out all targets. The inbound cruise missile has survivability issues of its own. The number of cruise missiles needed to attack a significant percentage of targets in a hypothetical major campaign adds up to greater cost than the penetrating attack bomber. Many types of both mobile and deeply buried targets cannot be confidently struck with stand-off weapons. A target can reposition during the cruise missile's time of flight. Hardened targets require hits with multiple, heavier weapons.

Extensive Target Sets. World events compel us to consider new target sets that may not have been as great a concern five years ago. The bomber force is a unique strategic tool; however it is also indispensable in missions associated with theater war plans. Bombers may have to attack airfields to suppress enemy air forces; help hunt, contain and destroy enemy surface naval vessels and submarines; and counter enemy air defenses. We all hope America won't need to use these capabilities; however, effective deterrence depends on having modern stealth bombers ready to do so.

Persistence. These target sets will truly test the persistence of the force. The bomber force must be persistent – that is, able to continue attacks day and night, in all conditions, for as long as needed. Persistence builds effect through continuous, unrelenting strikes as required to achieve the joint force commander's goals.

Sortie Generation. Sortie generation is key to persistence. The bomber force should be able to generate 30 or more sorties per day at maximum capacity. This is to cover multiple target areas, in two widely separated theaters. Precision weapons are a given but bombers cannot be in two places at once. A sizeable force is necessary to hold at risk mobile targets because they are hard to locate. For reference, the USAF deployed 66 B-52Gs in 1991 for Operation Desert Storm and flew an average of 40 sorties per day (ranging from 27 on 20 Jan 91 to a high of 51 on 11 Feb 91. Data is from the Gulf War Air Power Survey, Volume 5, pages 22 and 246.)

Maintainability. Maintenance is also crucial to sortie generation. The new bomber must be designed from the start to make component replacement easy for the flight line maintainers. The USAF should consult its B-2 crew chiefs in particular to gain their insights and feed this back into the design process.

A Note on Risk Reduction and Cost

Extensive design work for risk reduction is the final step to ensure capability. Fear of technical risk stretching acquisition timelines has overshadowed many current programs. However, it can't be solved by adhering to cost targets alone. It takes sound evaluation of risk levels at preliminary and critical design review.

Risk Reduction. The Air Force says it has funded extensive risk reduction for both competitors. The winning design will be far more mature than the B-2 design at EMD award. For example, the USAF via the Rapid Capabilities Office selected typical high-risk features such as propulsion integration, and apertures and antennae integration, and commissioned risk reduction work. This approach is somewhat new in bomber design, and reflects lessons from an array of other manned and unmanned programs. Careful risk reduction prior to EMD has created a much different position. Instead of asking competitors to turn in designs meeting minimum performance standards, the risk reduction for LRS-B has proceeded significantly further than with B-2, F-22 and F-35. This means the Department of Defense's final choice of a winner will reflect analysis of readiness for manufacturing and production to adhere to schedule and cost targets. These steps normally begin in earnest after EMD – here, the USAF has taken a rather bold new path that lets officials judge not just design quality, but the factors in a seamless transition to manufacturing. It also means that the USAF can be more certain the winning design truly has the mandated margins for upgrade capacity, extra power, range, etc.

Cost. The extensive risk reduction and design work for this bomber prior to EMD award should increase confidence in cost estimates. Target cost has been a factor in design decisions. Advances in technology make it entirely possible for a bomber somewhat smaller than the B-2 to come in at or under the cost target because designs and component technologies are mature. Of course, future program management factors such as yearly unit quantities, inflation, or truncated buys could affect cost far more than EMD.

Dr. Rebecca Grant

Dr. Rebecca Grant is President of IRIS Independent Research, a public-policy research organization in Washington, DC. Dr. Grant earned her Ph.D. in International Relations from the London School of Economics, then worked for RAND and the offices of the Secretary of the Air Force and Chief of Staff of the Air Force. In 1995, she founded IRIS Independent Research, performing work on strategic planning for aerospace and government clients. Recent studies for the Air Force have included analysis of major campaigns from Kosovo to Afghanistan and Iraq; evaluation of air base ground defense concepts; and research on long-range strike; and tracking of the military aircraft industrial base. For the Navy, recent studies include development of metrics for Phase 0 shaping operations for Fleet Forces Command; and a study of carrier aviation concepts and roles for the new CVN-78 Ford-class carrier for PEO-Carriers. Other studies have included research on global ISR requirements; and stealth maintenance and modernization issues.

She is also Director of the Washington Security Forum, a new research node for security topics. Her latest publication from the Washington Security Forum is The Case for a New Stealth Bomber published in February 2012.

Dr. Grant writes regularly for Air Force Magazine and has appeared on The Military Channel and other television as a commentator on airpower. She lives in the Washington, DC area with her husband, her seven year-old daughter, her motorcycle and a Tennessee Walking Horse named Red.

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Witness name: Rebecca L Grant

Capacity in which appearing: (check one)

(•) Individual

( ) Representative

If appearing in a representative capacity, name of the company, association or other entity being represented: N/A

Federal Contract or Grant Information: If you or the entity you represent before the Committee on Armed Services has contracts (including subcontracts) or grants (including subgrants) with the federal government, please provide the following information:

2015 No Federal or Foreign Government contracts in 2013, 2014, 2015

Rebecca L Grant 9/8/15

Federal grant/ contract	Federal agency	Dollar value	Subject of contract or grant

QUESTIONS SUBMITTED BY MEMBERS POST HEARING

SEPTEMBER 9, 2015

QUESTIONS SUBMITTED BY MS. BORDALLO

Ms. BORDALLO. The LRS–B will have a much higher per-unit cost than our current fighter aircraft. However, achieving the strike power of a single long-range bomber takes dozens of fighters. Given that operating a dozen fighter aircraft presents an operation and sustainment bill far in excess of what it would take to support a bomber, What can the Air Force and DOD do to more clearly articulate a long-term enterprise view for the LRS–B?

General ELDER. The fall of the Berlin Wall and the collapse of the Soviet Union changed the focus of the entire DOD from deterrence and preservation of global stability to expeditionary operations focused on regional instabilities and restoration of regional stability. No longer did the U.S. face a global threat, and with the implementation of Goldwater-Nichols, combatant commanders rightly emphasized planning for regional contingency operations with assigned forces rather than depending on out-of-area capabilities such as long-range strike bombers. The success of Desert Storm strengthened the belief that long-range airpower had become a niche capability, although this perspective failed to consider the impact of bombers flying from bases outside the region. Operations in Bosnia and Kosovo reinforced this misperception. Operations in Afghanistan and Iraq again highlighted the value of bombers. LRS–B and the legacy bombers are not niche capabilities—sufficient numbers are important.

It is important to ensure that the American people, particularly key decision-makers, understand the unique role of long-range strike bombers to the success of U.S. military operations abroad. Specifically, long-range strike bombers can reach targets across the globe without the need for costly and time-consuming expeditionary deployment. This provides the Nation a rapid response capability at the outset of a crisis which can be transformed later into one providing persistence strike capabilities for extended operations.

LRS–B benefits from the Open Mission System (OMS) lessons gained on other Air Force platforms. The OMS approach will enable LRS–B to incorporate new technologies throughout its long service life at much less cost than its predecessors. To put this in perspective, the capabilities of today's bomber fleet are significantly greater than the capabilities these same platforms possessed when they first entered service. The same evolution in capability will be true for the LRS–B, but upgrades will occur more often and at less cost.

With a fleet properly sized to meet Combatant Commander demands, which should equate to one combat-coded bomber squadron for each of the ten Expeditionary Air Forces, the Air Force will also be able to obtain economy of scale when sustaining the LRS–B fleet, making it less costly to operate.

Finally, the LRS–B will provide never-before-seen advantages for operations in contested (anti-access/area denial) environments. Leveraging low probability of intercept (LPI) networking capabilities developed for use in current fighter platforms will enable the LRS–B to employ new concepts of operation which will increase its survivability and mission effectiveness.

Ms. BORDALLO. We have learned a lot over the past 14 years of operations in Afghanistan and Iraq about the need to securely link ISR data with responsive firepower and access to the command and control network. The MQ–1 Predator and MQ–9 Reaper were pioneers in this regard—linking sensors, firepower, and data links in an incredibly potent fashion. What steps need to be taken to ensure the LRS–B harnesses a similar approach?

General ELDER. Earlier bombers were initially designed to fly as standalone platforms incorporating all the necessary sensors and self-protection capabilities to ensure individual bombers could deliver their weapons on target using only their organic capabilities. When datalinks and other technologies which provide connectivity to external sources of information were developed, the legacy bomber fleets were modified to incorporate these new systems. This postured them to operate more effectively as part of large force packages and employ precision weapons with "real-time" information. But in general, these external data capabilities were "strap on" modifications rather than fully integrated system solutions. The LRS–B was designed to be a key element in the future networked force, so it will incorporate exist-

ing stealth communication technologies equal to, or better than those on today's most advanced platforms. Unlike legacy bombers, these capabilities will be fully integrated into the operation of the LRS–B weapon system. With the use of Open Mission Systems (OMS), the LRS–B will be able to easily incorporate new C2 network capabilities, links and other sources of data as they become available, and fully integrate new external sensors and other sources of information. In short, next steps to ensure the LRS–B can securely link ISR data with responsive firepower and access to the command and control network throughout its service life should focus on advancing and implementing open mission systems to the greatest extent possible.

Ms. BORDALLO. The LRS–B will have a much higher per-unit cost than our current fighter aircraft. However, achieving the strike power of a single long-range bomber takes dozens of fighters. Given that operating a dozen fighter aircraft presents an operation and sustainment bill far in excess of what it would take to support a bomber, What can the Air Force and DOD do to more clearly articulate a long-term enterprise view for the LRS–B?

Mr. GUNZINGER. While unit costs and operation and sustainment (O&S) costs should inform development of the future force, DOD and the Air Force should articulate how requirements for bombers and fighters are driven by different operational needs. They should also explain how fundamental aeronautics principles govern the design of advanced military aircraft. Combat aircraft designed to carry bomber-sized payloads over very long ranges may not have the ability to out maneuver surface-to-air and air-to-air threats. Similarly, combat aircraft designed to optimize their stealth characteristics—such as the B–2 "flying wing"—may not be highly maneuverable.

I anticipate that DOD has sought to optimize the LRS–B's stealth, range, and payload capabilities simultaneously. These characteristics will greatly increase our Nation's penetrating strike "magazine depth." LRS-Bs should also be capable of carrying large, specialized munitions that are effective against hardened or deeply buried targets that cannot be carried in the internal weapons bays of much smaller fighter aircraft.

That said, pairing heavy strike aircraft such as the LRS–B with high-performance fighters will increase options for U.S. commanders and complicate the defensive challenge for our Nation's enemies. For instance, high-performance fighters can escort penetrating bombers or help suppress enemy defenses to allow LRS-Bs to achieve their missions.

Bottom line, while fighters and bombers have different unit and O&S costs, they are complementary capabilities. DOD and the Air Force should articulate a case for why both are needed by our Nation's warfighters.

Ms. BORDALLO. We have learned a lot over the past 14 years of operations in Afghanistan and Iraq about the need to securely link ISR data with responsive firepower and access to the command and control network. The MQ–1 Predator and MQ–9 Reaper were pioneers in this regard—linking sensors, firepower, and data links in an incredibly potent fashion. What steps need to be taken to ensure the LRS–B harnesses a similar approach?

Mr. GUNZINGER. MQ–1 Predators and MQ–9 Reapers are the product of ad hoc requirements and development processes. Their C2/ISR linkages are far more "clunky" compared to what should be expected of the LRS–B. Moreover, while Predators and Reapers were effective in Iraq and Afghanistan, they are not well suited for operations in contested or denied environments. LRS–B design teams have the advantage of applying lessons-learned from development of the MQ–1 and MQ–9 as well as the most advanced stealth airplanes in the world, the B–2, F–22, F–35, and B–2. They also have considerable experience in designing advanced low probability of intercept/low probability of detection (LPI/LPD) communications systems. As a consequence, it should be expected that LRS-Bs will have advanced data link technologies—high bandwidth, low latency, LPI/LPD—and associated methods for fusing information. These capabilities would enable LRS-Bs to maintain near-real-time awareness of the threat environment using information from off-board and on-board sources. The LRS–B's sensor suite should also be a significant step forward from anything the Air Force now operates. The combination of advanced sensors, a state-of-the art communications suite, and large weapons capacity would make the LRS–B much more than a "bomber." It should have the potential to act independently with a vast array of weapons, perform as a key node that provides real-time situational awareness to other penetrating capabilities, and conduct net-centric, collaborative warfare operations as part of the long-range strike family of systems. In summary, the LRS–B should be capable of doing anything MQ–1s and MQ–9s can do with greater speed, range, payloads, and in highly contested operational conditions.

Ms. BORDALLO. The LRS–B will have a much higher per-unit cost than our current fighter aircraft. However, achieving the strike power of a single long-range bomber takes dozens of fighters. Given that operating a dozen fighter aircraft presents an operation and sustainment bill far in excess of what it would take to support a bomber, What can the Air Force and DOD do to more clearly articulate a long-term enterprise view for the LRS–B?

Dr. GRANT. Previous analyses have shown that one long-range bomber can often hit more targets than a dozen or more fighters. Add in extra supporting aircraft and the efficiency of the bomber stands out. Aircrew and maintainers are key drivers in combat aircraft sustainment costs. Crewing a dozen fighters may require up to 16 pilots based on war readiness manning. A bomber like the B–2 may require only 2–4 aircrew to meet the same standards. This is just one quick example of how bombers provide significant aircrew cost savings from an enterprise perspective.

Ms. BORDALLO. We have learned a lot over the past 14 years of operations in Afghanistan and Iraq about the need to securely link ISR data with responsive firepower and access to the command and control network. The MQ–1 Predator and MQ–9 Reaper were pioneers in this regard—linking sensors, firepower, and data links in an incredibly potent fashion. What steps need to be taken to ensure the LRS–B harnesses a similar approach?

Dr. GRANT. Building a new long-range strike bomber will actually make it easier to ensure the bomber has sensors and datalinks to securely link to the command and control network. Software-programmable communications, the flexibility of AESA radar, and even potential laser-based communications links can be part of the bomber from the start. The Open Mission Systems practice developed by the USAF and used on systems like the B–2 will ensure that the new LRS–B can add in new communications, sensor and processing capabilities as technology advances.

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