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"Consolidation and the Future of Flight Test Facilities"

Keynote Address of
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Ladies and gentlemen, professional colleagues, it is an honor and my great pleasure to be with you and share some of my views on where the U.S. Department of Defense is headed to consolidate and affordably modernize its flight test facilities for the coming century.

Since that fateful day nearly a century ago when Wilbur and Orville Wright left their bicycle shop to achieve the long-sought dream of heavier-than-air flight, humankind has indeed come a very long way technologically—and much of that progress can be traced to the aerospace era that began with the Wright Brothers. In less than a century we have progressed from that first highly tenuous flight test at Kitty Hawk to the point where each day in the U.S. alone the equivalent of the population the city of San Diego climbs aboard commercial airliners and travels safely to their destinations.

The success of the Wright Brothers helped spur other seemingly outlandish theories, such as those of Robert Goddard, whose early rocket experiments in a cabbage patch in Massachusetts gave way exactly a century later to Neil Armstrong and Buzz Aldrin landing on the moon.

As an indication of how far, fast, and high aerospace has progressed, the entire first flight of the Wright Brothers could have taken place inside the huge external tank that today serves as the structural backbone for the Space Shuttle. Similarly, Goddard's most famous rocket reached an altitude about half as high as the Apollo launch vehicle—while the latter was still sitting on the pad.

To some extent we are now paying the price for our past successes. There are those who ask why we should build new airplanes when the ones we already have carry passengers to many of their destinations in less time than it takes to travel to and from the airport and await one's baggage. During the Cold War era many in the U.S. argued that the nation shouldn't buy the equipment our industry was producing because it wouldn't work. Today, on the heels of the Persian Gulf experience, these same people proclaim the

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nation shouldn't buy the equipment our industry is producing because it works so well that we don't need any more of it.

As I look broadly at the external environment that impacts our national security, I note that so many things have changed—not just in the past 20 years, but in the last year or two. In the post-Cold War world, we no longer face a single galvanizing threat such as the former Soviet Union. Instead there is increased likelihood of our forces being committed to limited regional military actions—coalition operation—in which our allies are important partners.

I would sum up our current national security environment in statistical terms by saying the mean value of our single greatest threat is considerably reduced. But the irony of the situation is that the variance of the collective threat that we deal with, plan for, and must counter is up.

This gives us some pause in trying to plan intelligently. In response to reduced mean value of the threat, the United States has cut end strength by about a third from 1985 levels. But at the same time, the increase in variance has caused deployments of U.S. forces to go up by a third—a fact that I am sure you are well aware of.

In fact, most informed observers realize that the overall U.S. defense budget has been cut by about a third in real dollars since its peak in the late 1980s. But what most don't grasp is that for every percentage point that the overall DoD budget changes, either up or down, the procurement budget invariably changes by two percentage points. Thus procurement funding is down by about two-thirds—actually 72 percent. Procurement has traditionally been the most volatile component of the budget in a draw down because it is not necessary to purchase new equipment for a smaller force structure.

But consider for a moment how such reductions impact the ultimate user of the equipment procured: the soldier, sailor, airman, or marine. One can readily calculate –by dividing the value of all the tangible assets the department owns, excluding land and buildings, by the annual reinvestment in those same assets—that the average item of military equipment in America's inventory will have to last 54 years. This in a world where technology generally has a half-life of anywhere from two to ten years and casualties in combat are heavily dependent on the quality of technology involved in the battle—as both sides vividly learned during the war in the Persian Gulf. Mindful of the aging equipment upon which our armed forces increasingly must depend, General Ron Fogleman, the Air Force Chief of Staff, this last year testified before Congress that, "We are living off the procurement of the past. It has to stop."

Because this approach defers long term modernization and future readiness, we view this as a temporary condition. The planned draw down is nearly complete with the FY96 budget, and so, from FY97 on, we will have to increase our spending to sustain modernization of the force. We have to start a ramp-up in modernization. And we have

to have a modernization plan that will focus on building a ready, flexible, responsive force for the changing security environment in which we live.

But I must be candid with you. We are making three critical assumptions about where we will get the money to make this work. The first big assumption in our defense planning is that the defense budget modernization line will stop declining and begin to go back up. This will depend ultimately on actions taken by the DoD and the Congresses two and three years from now. I am not confident that the projected increases we are counting on will be there in 2001. The difference in budget authority set by the Congressional Budget Resolution with that of the programmed budget shows an unsustainable ramp in the near term...and in the long term...It is a sobering state of affairs. But my concern is not directed only at the Congress. The DoD itself must continue to reduce infrastructure and to execute plans to achieve greater efficiency if we are to keep the rug from being pulled out from under our modernization plans.

This leads me to the second basic assumption in the Department's planning—that we will achieve significant savings by closing bases. As I said earlier, the DoD budget and force structure are both down about a third from their peak levels in 1985. Guess what? Our infrastructure is only down by 18%. It is the reason why the Base Realignment and Closure (BRAC) programs have been so important. The program we have laid out through BRAC 95 will reduce the infrastructure by an additional 11% over the next few years. It is important to bring this infrastructure into balance with our smaller force structure...the savings produced are needed to plow back into our investment program.

The third big assumption in our defense planning is that we will get significant savings by overhauling our defense acquisition system. The idea here is to be more efficient in what we buy; how we buy it; and how we oversee the buying process. As we look at the defense acquisition system in detail, what we find is that the system is not broken—it fields equipment that is second to none in the world. What we find is that the system can and must operate more efficiently.

Our flight test capabilities and resources are key players in this challenge to modernize our forces. In the U.S., most of our flight test facilities are a part of the Major Range and Test Facility Base (MRTFB), a national asset comprised of the 21 principal T&E centers, including ranges. It includes 21,00 square miles of land –about 55% of the Department's land assets, 243,000 square miles of water surface, and 221,000 square miles of airspace. It represents a $30 billion investment and at its peak in FY91 employed over 55,000 military, government civilians, and contractor personnel—now closer to 45,000. The facilities themselves are part of the infrastructure we need to consolidate and make more efficient. The capabilities they provide represent one of the areas in which we have the potential to more affordably acquire the needed weapon systems.

In light of the circumstances in which we find ourselves, the question confronting the flight test community is "Now what do we do?" The first most obvious choice—and to some the favorite choice—is to do nothing: hunker down, and hope that with a little

more time things would get better. This strategy is founded—or more accurately foundered—on the suggestion of John Lowenstein of the Baltimore Orioles, who when asked what could be done to improve the game of baseball, answered, "They should move first base back a step to eliminate all those close plays." Hoping that somehow, someone would move the bases back to give a little breathing room simply isn't going to happen. Our problems are more profound and all things considered, history has not been kind to those who have followed the "stay the course" approach when faced with profound shifts. Emblazoned in this hall of fame are such names as American Motors, Pan Am, Penn Square, Wheeling Pitt, and a host of others. If our flight test profession is to remain a quality, competent, and capable resource we cannot simply wait for the current crisis to pass. As a colleague of mine says, "Hope is not a strategy."

If the answer is not to do nothing, the canonical solution proposed by many politicians, academics, and media after every downturn seems to be to diversity. The aerospace industry itself has certainly tried this before. In spades. Examples of the things the industry has demonstrated it cannot produce at a profit include guitars, buses, monorails, pagers, solar energy systems, oil skimmers, modular housing, and a host of other ill-considered pursuits. In fact, the industry will tell you that its record at diversification is largely unblemished by success. Theirs a textbook case of failing to understand their core competencies.

Likewise these days one is likely to find all varieties of "innovative" endeavors being pursued on our test ranges in an effort to preserve and more fully utilize our infrastructure—some more or less aligned with our profession. It is not unusual to find race cars, motorcycles, even skiers in our wind tunnels. We employ our radar systems to monitor our borders in support of the war on drugs. And one of our test ranges is actually in the geothermal power business! And while we have for the most part succeeded in these endeavors, there has by and large been only marginal value added in these areas. Lest I be misunderstood, diversification is important—and can be accomplished successfully and profitably—but it has to be pursued very deliberately over a period of time. The fundamental problem is that Washington can cut the defense budgets faster than we can create new jobs and revenue through diversification.

But if doing nothing is not the solution—and if doing something different is not the solution—what then is the solution? It may seem that we have encountered the situation once described by Woody Allen in the following terms: "More than any other time in history, we face a crossroads. One path leads to despair and utter hopelessness. The other, to total extinction. Let us pray that we have the wisdom to choose correctly." If we desire to proceed, perhaps we should turn to a higher order of collective wisdom—namely the timeless counsel of that great American philosopher, Yogi Berra. Mr. Berra advises, "When you come to a fork in the road, take it." And he is quite correct: Some reasonable, decisive action is almost certainly better than no action at all. The preferred solution thus becomes one of doing that which we already have learned to do so well—but to become increasingly efficient at it through consolidation and proactive planning for the future.

Our DoD is preparing such a decisive plan for its test and evaluation centers for the twenty first century. This plan, entitled Vision 21, will serve as our blueprint by outlining the process that will enable DoD T&E centers to meet the needs of the warfighter, both now and in the future, despite a changing threat environment and reduced budgets. Vision 21 will rest on three pillars: reduction, restructuring, and revitalization.

- **Reduction** of current infrastructure costs with particular emphasis on the elimination of old, high-maintenance, and inefficient facilities while retaining critical capabilities for the future.

- **Restructuring** to capitalize on the reengineering revolution sweeping both government and industry and offering a rare opportunity to shed many of the old constraints that reduce our productivity and efficiency.

- **Revitalization** to modernize aged T&E centers, with emphasis on technologies of the twenty first century, cross-service sharing, improved efficiencies, and reduced cost of operations and maintenance.

We view this plan as an opportunity to respond to the needs of both the U.S. forces and the nation with a positive look to the future that leaves behind the remnants of the Cold War, ensures the security of the country, and provides for the necessary modernization of our defense capabilities.

I will briefly address each of the three pillars in turn, beginning with **reduction**. There have been a number of separate initiatives that have and continue to result in reduced test infrastructure, the most important of which is the Base Realignment And Closure (BRAC) process referred to earlier. It should be noted again that the effect of these consolidations and closures has yet to be fully realized, but significant reductions in DoD infrastructure are intended to result from the four rounds of Congressionally approved base closures and realignments in fiscal years 1988, 1991, 1993, and 1995. Only the BRAC 88 decisions have been fully implemented. The BRAC91 actions are currently in process, and only a few of the BRAC 93 and BRAC 95 actions have even been started. Clearly, the most significant of the BRAC consolidations and reductions remain to be executed. And equally clearly, while we are committed to retaining our critical land, sea, and air space, we have not seen the last of our reductions in test facilities.

The bad news here is that it takes money to save money. When we close down facilities, we actually end up spending money in the near term. Typically it takes between two to three years to break even before there is a net savings in the process. But we have to succeed in our plans for closing facilities. Yet since test facilities need adequate capacity in order to provide support that is cost effective to weapons programs and the DoD as a whole. The question is how much is enough.

The plethora of consolidations has raised several profound policy questions: the principal one of which is at what point are the capabilities and resources which have been so essential in the past undermined? My answer to that question is straightforward: It is much better to have two or even three exceptional facilities than one. Unfortunately that choice is basically irrelevant since it is not among the options we have been given. Unfortunately the defense budget has been cut so deeply that even the choice of having two strong complementary facilities may not always be available. The debate about whether we would rather have ten facilities—or nine or six or three thus takes on the same connotation as arguing about the number of angels that can dance on the head of a pin.

In order to fulfill our test mission in the face of this reduced and reducing number of facilities, we have taken a number of initiatives. The military Services established the T&E Reliance Project in 1990 as a corporate and cooperative management approach to promote coordinated, centralized investment planning without inhibiting decentralized execution of testing. Under Reliance, a single manager or Lead is generally assigned responsibility for planning for DoD test capability in a specific area, e.g., electronic combat. The Lead is responsible for fostering cross-service management arrangements, identifying unwarranted duplication, and making recommendations to improve test facility management.

In 1995, National Aeronautics and Space Agency (NASA) and DoD Integrated Product Teams were formed to evaluate where consolidations, improvements in efficiencies, and cost savings could be identified and obtained between the two agencies. Particular emphasis was placed on more efficient management of technology programs and the major facilities of both agencies. The teams gathered information on major facilities used by NASA and DoD since 1993 and reviewed future workload requirements. To ensure future and continual coordination, alliances are being recommended among DoD, NASA, industry and appropriate universities. These alliances are responsible for monitoring and improving the use of facilities, reducing costs through commonality, and improving test technology by endorsing facility investments. Interagency Reliance and co-management of facilities are being considered.

On another front, an emerging sense of mutual need and interdependence is being fostered between test and training ranges. Since both test and training share certain functional requirements, ranges and range instrumentation have similar characteristics for the respective applications. The Joint Test and Training Range Roadmap describes a conceptual vision of a range structure that supports seamless, integrated operations across the physical boundaries of designated cooperatively linked test and training ranges. The vision, along with a general strategy and business plan, provide a framework for making decisions on development and acquisition of future range and instrumentation systems. The focus is on presenting a range paradigm that will lead to more effective and efficient use of the existing and projected range resources and enable mutual test and training use where required and appropriate.

Now, since growing by shrinking is a bounded strategy, the second pillar of Vision 21, **restructuring**, places the emphasis on providing more efficient and affordable testing through better planning, better processes, better business practices, and better teaming.

It is clear that the bulk of our money is spent on manpower—at least 54% for government personnel and an additional 15 percent for contractor services. This should not be surprising—it is common for most industries—but interestingly, many people outside the test and evaluation business who want to promote a pet "reinvention" scheme fail to appreciate this fact. Fundamentally, manpower is the high leverage point—if a reinvention idea does not reduce required manpower, it will not have significant impact. Closing facilities is a good example: if we reduced facility ownership costs to zero, we would save less than 5 percent of our budget. So facilities—moved, closed, or consolidated—are not a high payoff area unless the closing or moving also saves manpower.

A disciplined planning approach provides the basis for looking at how we do testing and for identifying better ways of producing our products. If we look at a work breakdown by facility and manloading—considering a spectrum from digital modeling and simulation to open air range testing—we find that open air testing accounts for only about 30 percent of the work we do—but it accounts for over 60 percent of our manpower. Since manpower is a high-leverage commodity, this highlights a real potential for reducing the cost of doing business. We can pursue two strategies: We need to either dramatically reduce the manpower costs associated with open-air testing, or we need to reduce the amount of open-air testing. We have chosen to emphasize the latter option because we not only reduce the cost, we also get better results.

Our basic concept of testing uses a building block approach that starts with digital modeling and simulation to predict the test item's responses before any hardware exists. As hardware is produced, the hybrid testing phase begins where the test item is subjected to increasingly more complex, simulated environments. Our approach to better testing is to depend on hybrid environments because we get a better understanding of the system under test at a lower cost. Hybrid testing begins with basic parametric measurements of the components and subcomponents, continues through the integration of those components into subsystems and proceeds to the installation of the systems in their host platforms in a synthetic test environment. The final proof remains in the open-air testing, but we believe this very expensive stage should not begin until their is high confidence we know how the system works. Of course, simulation and analysis provide the reference base throughout the testing process and are the repository for our understanding of the system. This integrated approach to test and evaluation is the principle embodied in some of our premier test facilities: the Electronic Combat Integrated Test facility at Edwards AFB and the Air Combat Environmental Test and Evaluation Facility at Patuxet River.

Another side of decreasing the cost of testing is to increase the productivity of our assets. Three years ago the Air Force Developmental Test Center set the goal of achieving the same utilization rate for their test aircraft as the operational forces have.

This approach is not usually taken with a test fleet for a variety of reasons, but they were able to achieve this increased level of output in about a year. The real payoff came when they resized the test fleet to match the higher utilization. Because they now need fewer aircraft to fly the same number of sorties, they have been able to cut the fleet size in half while still flying the same number of test hours. With these actions, they were able to realize some very significant savings in maintenance manpower, with a direct reduction in infrastructure support costs.

Arnold Engineering Development Center, facing an aging test infrastructure and a growing maintenance backlog, is seeking to implement a non-bureaucratic maintenance management system addressing the availability, reliability, and affordability of their infrastructure. One of their principal focuses has been to acquire a modern Computer Maintenance Management System. The efficiency improvements this system promises has the potential for saving the center $49.5 million over 5 years. It is important however, that the process which the new system supports be appropriately reengineered before its introduction to avoid having a good tool supporting a bad process.

It is this sort of investment that turns us to the third pillar, **revitalization.** Most of our test facilities were built in the early stages of the Cold War. More than two thirds of the infrastructure is over thirty years old—with the average age being well over forty years. During the last twenty years, DoD's investment rate for the T&E facilities had been less than one third of the rate of investment in private industry and an order of magnitude below the investment rate for high technology industries. These facilities need to be revitalized to:

- Address testing of new technologies such as smart weapons, low observable systems, complex electronic systems, and space systems.

- Replace outdated technology and single Service approaches with state-of-the-art instrumentation and facilities that satisfy joint Service needs.

- Replace inefficient, labor intensive T&E resources with modern, cost effective capability to meet the needs of the twenty-first century.

Today's weapons employ technology that was virtually unknown at the time most of our test capability was established and much of it is unsuited to the needs of modern flight testing. Just consider one underlying change affecting traditional aerospace—namely transformation from being principally focused on "aluminum bending" to becoming increasingly involved in large scale electronics system integration. The term aeronautics was originally coined to describe "air-flight" developments that grew in some ways out of "nautical" principles. When airframes began yielding in part to space vehicles, the term "aerospace" was born. Today we are no longer dealing with aerospace; we are in what might more accurately be characterized as the "aeroelectrospace" era.

As part of this revolution, the fraction of electronics in defense equipment has grown from about one percent in World War I to about five percent in World War II to 45 percent today...and the fraction continues to increase. Correspondingly, about 10 percent of the weight and one-third of the cost of modern combat aircraft are composed of electronics and related components. Principal among the latter is software—a substance that weighs nothing but costs inordinately. I would contend that the "aeroelectrospace" era is fundamentally different from the one in which the Flight Test Center at Edwards AFB was conceived.

At the same time that our investments in T&E are declining, maintenance costs are increasing and productivity is decreasing due to age and outdated technology. For example, the Propulsion Wind Tunnel facility at Arnold Engineering Development Center faces declining availability and maintainability in several areas. For example, two old and inefficient electric induction motors driving the 16-foot transonic and supersonic tunnels' compressors are an Achilles heel of the facility's operations. These motors were designed over 45 years ago, are not environmentally friendly, and halt tunnel operations whenever they fail. A $65M sustainment program over the next 7 years will be required to correct this and other deficiencies but will reduce operating costs due to greater efficiencies, fewer subsystem failures, and reduced run time.

The impact of inadequate investment in test capabilities is reflected directly in our ability to affordably modernize the forces. The effect on acquisition programs is seen in several ways:

- Time to test is increased by the decrease in availability of older, more difficult to maintain test capabilities resulting in cycle time impacts on programs.

- Costs to test are increased because the lack of investment in the capabilities needed for emerging cost effective T&E methodologies.

- Risk in programs is increased as our test and measurement capabilities lag the technologies we are testing.

On the other hand, with proper investment in test facilities, we are achieving some significant successes through recently fielded systems that have increased both the effectiveness of our testing and its efficiency. Examples of this are the common airborne instrumentation system (CAIS) now flying on the F-18E/F, the Smart Munitions Test Suite—a mobile system critical to missile defense testing, and the Next Generation Target Control System (NGTCS) which will allow targets to be controlled by an interoperable system and permit their use at any range—whether testing or training. This is a key capability for many programs with the Aegis program office a prime beneficiary.

The benefits to be gained from innovative, modern T&E capabilities are manifold. The Naval Air Weapons Center at Patuxet River used the Air Combat Environmental T&E Facility to reduce flight test hours and cost by a third in testing equipment on board

the EA-6B aircraft. The Aerial Cable Test facility at White Sands Missile Range has saved projects over $20M in the first year of operation by reducing missile firings and in-flight testing. At Eglin AFB, use of ground simulation led to a 35% reduction in cost and a 300% increase in data capture during flight test of the APG-63 radar.

Having embarked on this three-pronged approach to the consolidation and future planning for our test facilities, there are obviously many challenges facing the U.S. flight test community along the way—not the least of which are legal obstacles. New legislative authorities will likely be required in order to maximize the potential now held captive by a lengthy list of statutory requirements and regulations.

Undoubtedly one of the principal impediments to effective rationalization relates to the time required for this process to pursue the necessary coordination and determination—a time scale that simply is not compatible with the pressures of the environment in which we exist.

Long periods of uncertainty, where employees do not know for whom they will work, where they will work, and who will pay their pensions, are not conducive to high morale and enthusiastic performance. Similarly customers—program managers-- are reluctant to plan major test programs at facilities where it is uncertain what the future of that facility is going to be. And comptrollers are reluctant, in fact, down right resistant, to permit much needed investment in any facility that has a whisper of reduction in its air. We cannot continue to cut the tail off of the cat an inch at a time. If we do not decide on and proceed with a clear path for the future of our flight test resources, the decisions will be made for us—perhaps by default.

We must get on with it! Vision 21 with its three mutually supporting pillars: reduction, restructure, and revitalization, is the U.S.'s approach to the consolidation and future of our flight test facilities. I believe that

- A decisive plan is essential for the future of flight testing, and
- All three pillars are required for an effective plan.

Change has been likened to a dragon. You can try to fight it, but you most likely will end up losing and not surviving the battle. Or you can jump on its back and ride it. It may be a wild ride, but at least you'll be where its going when it gets there.