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UNMANNED AIRCRAFT SYSTEM IN ALASKA AND THE PACIFIC REGION: A FRAMEWORK FOR THE NATION

HEARING

BEFORE THE

COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION UNITED STATES SENATE

ONE HUNDRED NINTH CONGRESS

SECOND SESSION

JULY 13, 2006

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ONE HUNDRED NINTH CONGRESS

SECOND SESSION

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UNMANNED AIRCRAFT SYSTEM IN ALASKA AND THE PACIFIC REGION: A FRAMEWORK FOR THE NATION

THURSDAY, JULY 13, 2006

U.S. SENATE,
COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION,
Washington, DC.

The Committee met, pursuant to notice, at 2:30 p.m. in room SD–562, Dirksen Senate Office Building, Hon. Ted Stevens, Chairman of the Committee, presiding.

OPENING STATEMENT OF HON. TED STEVENS, U.S. SENATOR FROM ALASKA

The CHAIRMAN. I might state at the outset, we have four votes scheduled to commence right now at 2:30. Is it 2:45 now? 2:45, and we want to continue this hearing as long as we can before we have to go over to vote and we will come back as quickly as we can.

Unmanned aircraft have been used by the military since World War II. The Army Air Corps, in which I served, used B24s loaded with explosives and remotely piloted them into Nazi Germany. Back then pilots took these aircraft off and jumped out once the plane was airborne—the planes would then be remotely flown to the target. In fact, our good friend, Senator Kennedy's oldest brother, Joe, died in one of those unmanned aircraft.

Today, unmanned aircraft can fly by themselves and they're playing an intricate part in fighting the War on Terror. This is a Raven. It weighs, I'm told, about four pounds and there are about 4,000 of them now deployed worldwide in the War on Terror, particularly in Afghanistan and Iraq. Young sergeants launch and fly these unmanned aerial vehicles (UAVs). First responders like the Forest Service fire fighters who use systems like this are required to file a flight plan and to have approval of the FAA. The Global Hawk, which has a 130-foot wingspan and weighs over 32,000 pounds and flies up to 60,000 feet. It is certified for flight operations and is cleared the same way as this Raven would be cleared.

We've asked the FAA to testify today and we hope to be able to work with all of you and work together to get these UAVs classified and approved for non-military use. More importantly, we hold this hearing today so we can discuss how the unmanned aircraft service can help the missions of NOAA and the Coast Guard, two very important agencies whose missions are to protect and save lives, and are probably subject to the jurisdiction of this committee. From climate research to search and rescue, there are boundless opportunities for these unmanned aircraft to help these agencies better accomplish their missions and it is my hope that we will be able to discuss whether Alaska and the Pacific region in general is the best place to test these unmanned aircraft systems.

Senator Inouye, do you have a statement?

STATEMENT OF HON. DANIEL K. INOUYE, U.S. SENATOR FROM HAWAII

Senator INOUYE. When one considers that the Pacific area makes up about half of the exclusive economic zones of the United States and we are not able to cover that by manned aircraft, or manned vessels, I think this makes good sense. Mr. Chairman, I'm all for it.

[The prepared statement of Senator Inouye follows:]

PREPARED STATEMENT OF HON. DANIEL K. INOUYE, U.S. SENATOR FROM HAWAII

Mr. Chairman, I am pleased we are evaluating the potential uses of unmanned aerial systems (UASs) for non-defense purposes in the Pacific Region.

The Department of Defense has made good use of these systems, but they have tremendous potential for civil applications for a variety of purposes, from research to enforcement.

As you know, the Western and Central Pacific exclusive economic zone (EEZ) constitutes a full 46 percent of the entire U.S. EEZ. It is a vast area that we are not yet able to cover sufficiently with manned vessels and aircraft.

I hope that our witnesses will discuss how we can safely use UASs in our region, especially to fill the gaps needed to monitor foreign incursions into our EEZ, or improve protection of our marine resources, particularly in our marine sanctuaries and the Northwestern Hawaiian Islands.

I am pleased the agencies have proposed using existing air bases in Hawaii as part of these efforts. I would like to know more about the costs, technical feasibility, and safety precautions we would need to have in place for such a program to proceed.

I want to stress that we must retain and strengthen our manned capabilities in the region. These systems cannot supplant them. The advantage of the unmanned systems is that they can fill gaps that we cannot now cover with vessels and aircraft.

I look forward to learning how we may move forward. However, public safety is of paramount importance. These systems should be used to enhance, not erode, our existing monitoring and enforcement capabilities.

We must have realistic expectations of what these systems can deliver, and I hope our witnesses will keep that in mind.

The CHAIRMAN. Thank you, Senator. We will print your entire statement in the record.

We have testifying here today, Vice Admiral Conrad Lautenbacher, the NOAA Administrator; Rear Admiral Wayne Justice, the Assistant Commandant for Response, U.S. Coast Guard; Nick Sabatini, Associate Administrator for Aviation Safety for the FAA; and John Madden, Deputy Director of the State of Alaska Homeland Security Division.

Thank you all for coming today and we look forward to your statements. All of the statements will be inserted into the record and it's our intention to listen to all of you without any interruption as you go through your statements.

Admiral, you are first.

STATEMENT OF VADM CONRAD C. LAUTENBACHER, JR., U.S. NAVY (RETIRED); UNDER SECRETARY OF COMMERCE FOR OCEANS AND ATMOSPHERE; ADMINISTRATOR, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA), U.S. DEPARTMENT OF COMMERCE

Admiral LAUTENBACHER. Thank you, Mr. Chairman, Senator Inouye, and distinguished staff members here today. Thank you very much for this opportunity for this hearing to talk about our use and potential use of unmanned aircraft systems (UAS) in the future. Our goal, I think that most of you know, in NOAA is to create a world in which we can forecast much better in the future and much more accurately things like winter weather, storms, drought, air quality, and severe weather such as hurricanes and tornadoes. We're working together with a number of other agencies to build the Global Earth Observation System of Systems (GEOSS) in encompassing a network of all Earth-observing assets from space to the bottom of the ocean. We believe that UAS systems could play an extremely vital role in filling in the gaps that we have in a Global Earth Observing Systems of Systems, particularly in monitoring our oceans and our atmosphere. They provide unique capabilities for dirty, dull and dangerous missions. Dirty because they can fly into contaminated areas, dull because they allow for long transit times and open new dimensions of persistent surveillance and tracking and dangerous because they can fly into remote or hazardous areas impractical for manned flight.

We have recently begun exploring potential incorporation of UAS technology into our scientific and operational missions to improve efficiency. In July 2005, I convened an internal Unmanned Aircraft Systems Steering Committee and Working Group and asked this group to identify areas and activities within NOAA that could benefit from the use of UAS. The Group's response included climate and weather operations, oceanic and atmospheric research, monitoring fires and fisheries enforcement. Parallel to this effort, NOAA has completed four successful demonstrations on the potential ability of UAS to support our needs for mapping, observation, monitoring and surveillance. In one of these projects we flew a UAS into a tropical storm for the first time. This demonstrated the ability of UAS to obtain some new observations that could potentially help improve hurricane forecasts.

Our successful demonstrations laid the foundation for us to continue to test these platforms. Alaska is an excellent location for NOAA to develop a test program because of the unique diversity of NOAA missions there. For example, observing climate and ecosystem changes in many parts of that country, that state. In Alaska in the Arctic we have the snow, the permafrost and ice which magnify climate changes. UAS could collect additional measurements, especially over the Arctic Ocean which would help predict future effects of climate change.

Another NOAA mission to provide weather and climate information to enable safe transportation is also very important. We work with the National Ice Center in Anchorage and forecast sea ice year round for the military and fishermen. UAS could provide additional observations in an effort to improve these forecasts and warnings.

Volcanic and forest fire monitoring and forecasting also can be potentially supported by UAS. The volcanic ash is dangerous to jet aircraft and most of the volcanoes in the U.S. airspace are located along or around the Pacific Coast of Alaska and Hawaii. UAS could provide higher resolution, real-time data to improve plume position forecasting and minimize the risks to flights in our airspace. UAS could also survey forest fires during the day or night to detect hot spots and provide forecast data to enhance our partners' safe mobilization of fire crews.

A final example of a potential UAS mission is the monitoring and protection of marine resources along the State's 6,600-mile coastline. Protecting and mapping this vast area including the multi-billion dollar fisheries is daunting. UAS could supplement traditional enforcement methods and provide longer sustained monitoring at remote locations.

The potential benefits of UAS's capabilities extend beyond the many possible missions and activities in Alaska. As you know, President Bush recently designated the Northwestern Hawaiian Islands as a marine national monument. The monument is one of the least accessible of our national treasures.

UAS based in Hawaii could control the monument while collecting scientific data in support of NOAA's other missions. For example, a NOAA-supported demonstration flight showed a UAS based out of Kauai could potentially collect climate and air-quality data to provide improved forecasts for the continental United States.

NOAA has learned a great deal about the potential uses of UASs, their capabilities and the many ways in which they could help us to meet our missions. I say potential because at this point of our observation evaluations, several challenges remain, including FAA qualification for unrestricted or partially unrestricted use in current airspaces and how best to integrate these systems with our existing systems and the cost.

However, it's my belief that UAS capabilities have the potential to alter and improve significantly how we monitor and respond to changes in the Earth's environment and improve efficiency. They will in the future, in my view, become absolutely essential to our ability to provide the kinds of forecasts and warnings and monitoring that the world needs to sustain its economic and environmental quality.

With that, Mr. Chairman, I am happy to answer any questions you have and look forward to the hearing. Thank you.

[The prepared statement of Admiral Lautenbacher follows:]

PREPARED STATEMENT OF VADM CONRAD C. LAUTENBACHER, JR., U.S. NAVY (RETIRED); UNDER SECRETARY OF COMMERCE FOR OCEANS AND ATMOSPHERE; ADMINISTRATOR, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA), U.S. DEPARTMENT OF COMMERCE

Introduction

Thank you, Mr. Chairman and members of the Committee, for inviting me here today to present testimony on the potential use of unmanned aircraft systems, or UAS, to improve oceanic and atmospheric observations. I am Vice Admiral Conrad Lautenbacher, Under Secretary of Commerce for Oceans and Atmosphere and Administrator of the National Oceanic and Atmospheric Administration (NOAA) within the Department of Commerce.

Many of you may be familiar with NOAA's use of unmanned or autonomous underwater vehicles, but NOAA is also interested in unmanned aircraft systems (UAS) as a tool to explore and gather data to help us reach new heights in our ability to understand and predict the world in which we live. Use of UAS could help NOAA achieve our mission goals to conserve and manage coastal and marine resources to meet the economic, social, and environmental needs of our Nation.

NOAA constantly seeks better and more cost effective strategies to meet our mission goals and responsibilities, and this includes evaluating emerging technologies and the roles they could play in our work. UAS are an example of one emerging technology NOAA is exploring. My testimony today provides background on UAS as a potential platform for collecting data, and how they could be used to help NOAA accomplish its mission in Alaska and the Pacific, across the nation, and around the world as part of our global commitments.

Earth Observations: UAS Provide Complementary Data

The Global Earth Observation System of Systems (GEOSS) is an international effort that is working to link Earth observing systems from over 60 countries to improve global coverage. With benefits as broad as the planet itself, this U.S.-led initiative promises to make people and economies around the globe healthier, safer, and better equipped to manage basic daily needs. UAS could be a valuable part of GEOSS by contributing more information and improving our observational capabilities and forecasts.

UAS have the potential to provide more comprehensive information on atmospheric conditions in the area between satellites and surface-based sensors. For example, UAS can perform functions that satellites cannot, such as dropping specialized sensors (dropwindsondes) from high altitudes to obtain vertical profiles of crucial atmospheric variables. In other words, the dropwindsondes are able to take a series of measurements within a column of the atmosphere giving a "top-to-bottom" snapshot of conditions. These measurements include cloud properties, aerosols (small particulates), radiation (sun's rays or sun's energy), temperature, humidity, and winds. The complementary data that UAS provide could enable us to improve our weather and climate predictions.

UAS: Sentinels of the Sky

UAS are a developing segment of the aviation industry and are often used by U.S. military and intelligence agencies overseas. Civilian agencies, like NOAA, have only recently begun demonstration projects to test the mission-focused utility of these platforms. UAS could allow NOAA to carry instruments to remote locations too dangerous or impractical for manned flight, and provide unique capabilities for dirty, dull, and dangerous missions. Dirty, because they can fly into contaminated areas; dull, because they allow for long transit times and open new dimensions of persistent surveillance and tracking; and dangerous, because they can fly into hazardous areas minimizing the risk to human life.

Because UAS do not carry a human pilot, they function independently or remotely with ground-based operators. UAS launch from land, air, or ship-based platforms, and can carry internal or external payloads of scientific equipment. A typical UAS consists of the aircraft vehicle, a manned ground flight-control station, ground data retrieval and processing stations (including satellite communications links), and sometimes, the wheeled land-based vehicles that carry launch and recovery platforms. A comprehensive UAS base of operations also requires launch hangars and maintenance facilities.

UAS are highly sophisticated sensor platforms that can be selected, modified, and deployed to meet different missions. There are many different types of UAS; some have a wingspan as large as a Boeing 737 (93 to 112 feet), while others are the size of a model airplane (one foot). The payload capacities of UAS that NOAA has tested or examined can carry as little as one pound, or as much as 3,000 pounds of equipment. Flight endurance of UAS range up to more than 30 hours, and some can reach an altitude of almost 65,000 feet. Additionally, the instrument packages on UAS can be recalibrated or changed prior to each flight, providing a research platform that can be regularly altered to suit changing needs.

NOAA's Interest in UAS

Over the past few years, NOAA has considered how to incorporate UAS technology into our scientific and operational missions. In July 2005, NOAA convened an internal Unmanned Aircraft Systems Steering Committee and Working Group. This body is responsible for advising NOAA's line offices, goal teams, and programs on the potential application of UAS technology to meet mission goals. The Working Group has identified many diverse areas within NOAA that could benefit from the use of UAS, including:

- Climate and weather operations
- Oceanic and atmospheric research
- Monitoring and evaluating ecosystems
- Monitoring endangered species
- Mapping and charting
- Weather and climate satellite calibration and verification
- Monitoring fires
- Monitoring marine sanctuaries
- Fisheries enforcement

The Working Group has also identified common interests and coordinated collaborative activities with: the National Aeronautics and Space Administration (NASA); the Federal Aviation Administration; the Department of Energy; the National Science Foundation; the Department of Homeland Security including the U.S. Coast Guard; and academic institutions such as Scripps Institution of Oceanography and the Universities of Colorado, Alaska, Hawaii, and New Mexico. Since 2005, NOAA has worked with our partners to complete four successful UAS demonstration projects, and we have plans for more in the next few years.

From April to November 2005, NOAA and NASA successfully completed a series of high-altitude, long-endurance (HALE) Altair UAS flights off the coast of California and Oregon. The Altair UAS was initially built to support NASA's Earth science research needs. The Altair demonstration included five flights totaling 45 flight hours, including an 18-hour 45,000-foot high flight over the Pacific Ocean, carrying instruments for measuring ocean color, atmospheric moisture and chemical composition, and temperature, as well as a surface imaging and surveillance system. This project demonstrated the possibility of using a HALE UAS in support of NOAA's research operational needs for mapping, monitoring and surveillance.

In September 2005, NOAA, NASA and industry partners successfully flew an Aerosonde UAS into Tropical Storm Ophelia. At the time, Ophelia was a 55-knot tropical storm located off the North Carolina coast, and this marked the first time a UAS had flown into a tropical storm. This mission used the unique capabilities of UAS to document areas of the tropical storm environment near the surface of the ocean that have historically been either impossible, or impractical, to routinely observe by either NOAA or U.S. Air Force Reserve hurricane hunter aircraft. This demonstration showed the ability of UAS to obtain continuous low-level observations. These observations may be useful in improving future forecasts of hurricane intensity change when the information collected by these aircraft are incorporated into NOAA computer models used to predict hurricane track and intensity.

In February 2006, NOAA participated in a field demonstration of the aerial survey capabilities of the Silver Fox UAS over the Hawaiian Islands Humpback Whale National Marine Sanctuary. The Silver Fox is a small, low-altitude, short-endurance UAS that was developed with Office of Naval Research funding to function primarily as an expendable, over the horizon, surveillance tool that could be launched from ships or from land. At the demonstration, the Silver Fox UAS was used to observe surface ocean features, living resources, and vessels, and demonstrated the potential of UAS for monitoring threatened and endangered species like whales, as well as illegal, unregulated and unreported fishing activities.

During a demonstration project in February and March 2006, NOAA's Climate Program supported the use of three Manta UAS based out of Hanimaddhoo Island in the Maldives. The UAS were equipped with radiation and aerosol sensors to detect anthropogenic smog from India. The flights also coordinated with the ground-based measurements made at the Maldives Climate Observatory, part of NOAA's Earth System Research Laboratory Global Monitoring Division. This project demonstrated the ability of UAS to obtain new information about how aerosols and clouds regulate planetary albedo (light reflection), which can affect our weather and climate.

Potential Roles for UAS in Alaska

The demonstration projects outlined above show the potential utility of UAS in providing additional observational data to assist NOAA in meeting our mission goals. Alaska's location, size, and extensive coastline make it a unique setting to evaluate the potential contributions UAS can make toward achieving NOAA's mission.

Climate and Ecosystem Monitoring

NOAA is observing climate and ecosystem changes in many parts of the world, including Alaska and the Arctic region. UAS could provide additional climate observations lacking from the Arctic due to the physical and geographic challenges we face there. Long-term atmospheric measurements repeatedly taken from the same place are the "gold standard" for climate change detection. The Arctic Ocean—covered by sea ice most of the year—is a particularly difficult area to take long-term measurements because sea ice drifts, and the entire ice shield rotates clockwise. This means that stations established on the ice move, and repeated measurements cannot be taken from the same location. Long-term detailed measurements of temperature, solar radiation, clouds, and aerosols from fixed points over the Arctic Ocean would be helpful in advancing our understanding of the region and the extent of change that is occurring. UAS may be an effective platform to obtain these measurements because of their ability to go on long flights to remote areas, and because they can potentially deploy the sensors needed to take high-resolution measurements of critical atmospheric properties at fixed locations on a routine basis.

Operational Sea Ice Monitoring

As part of NOAA's mission to provide weather and climate information to enable safe transportation, NOAA's National Weather Service Weather Forecast Office in Anchorage, Alaska forecasts sea ice year round. NOAA partners with the United States Navy and United States Coast Guard to operate the National Ice Center, which provides global ice analysis and forecasts including strategic and tactical ice services tailored to meet the operational requirements of U.S. military. Sea ice is a major marine hazard in Alaska's Bering, Chukchi, and Beaufort Seas, and can trap and even crush a ship. Ship operators require precise up-to-date information on the location of ice edges, leads and open water, and the type and concentration of ice along their vessel's route. Anticipating sea ice formation is critical for maintaining navigational safety, and is essential for supporting Alaska's marine fisheries. Dropwindsonde and monitoring sensors released by a UAS could further NOAA's efforts in sea ice forecasting by providing timely information on the conditions that foretell rapid sea ice formation in the Arctic. This information could potentially assist in the dissemination of more timely and accurate navigation warnings.

Weather Observations and Predictions

Beyond the short term (6 to 12 hours), weather forecasts are primarily based on Numerical Weather Prediction (NWP) models. NWP model forecasts depend on the amount and quality of observational data regarding the current state of the atmosphere, land, and ocean surface conditions. Alaska lacks the conventional observational coverage present in the continental United States, and UAS could provide additional observations to improve weather forecasts and warnings. The potential improvements would not only benefit Alaska, but the nation, due to the prevailing storm track that steers many weather systems from the Gulf of Alaska and North Pacific toward the continental United States.

In addition to the NWP uses of UAS data, this real-time data could contribute to the database from which the National Weather Service (NWS) develops forecasts, watches and warnings. All of the NWS forecast and warning programs (public, marine, fire weather, aviation, and hydrologic) could directly benefit from these observations.

Fire Prediction and Surveying

The 2004 and 2005 fire seasons in Alaska were the worst since records began more than 50 years ago, with 6.6 million and 4.4 million acres burned respectively. There are several major advantages of using UAS for fire weather forecasting and fire prediction and surveying over Alaska, including its long-flight endurance and its capability of high-risk flights over dangerous or remote regions. UAS with the capability of flying for long periods could survey existing wild fires, detect hot spots, and help predict the weather conditions around wild fires and fire's future track.

NOAA's National Weather Service Weather Forecast Offices provide spot weather forecasts to enhance our land management partners' decision-making process. This assists with advanced mitigation planning and safe mobilization of fire crews during wild fire suppression activities in Alaska and around the Nation. These forecasts account for the potential influence of forest fires on local weather conditions and provide vital, localized detail on wind conditions and the impact to fire behavior. UAS are a potential tool for gathering site specific data on fire weather conditions to further improve NOAA's spot weather forecasts. In addition, UAS could provide valuable information on hot spots within a fire which could benefit fire weather forecasters and those responsible for coordinating firefighting resources. The long flight time of UAS would be particularly well-suited to surveying fires that occur in remote areas of Alaska. In addition to helping to forecast fire weather, UAS could help with predicting the threat of fires. NOAA scientists in Alaska analyze meteorological and soil moisture data to predict forest fire potential and issue fire warnings. UAS could potentially play a role in fire prediction by providing more meteorological data to validate fire advisory models.

Forest fires also impact air quality in Alaska and throughout the nation. Emissions of gases (carbon monoxide, ozone, oxides of nitrogen and sulfur) and aerosols from fires degrade the local air quality. Observations of these pollutants by UAS could improve our air quality models and extend the NWS Air Quality Forecast Guidance for ozone concentration averages across the country. In addition, emissions of trace gases and aerosols from forest fires and subsequent deforestation can affect climate change. The use of UAS to collect data on these emissions from remote areas has the potential to impact NOAA's efforts to better understand climate.

Volcanic Monitoring and Forecasting

Volcanic ash is hazardous to aircraft flying over Alaska and the entire North Pacific Region, as well as to the maritime community and general public. The national and international aviation communities have taken action to help aircraft avoid such dangerous environments. In the mid-1990's, the International Civil Aviation Organization (ICAO) and NOAA reached an agreement whereby NOAA monitors satellite imagery and data to detect volcanic eruptions and, in the event of an ash eruption, issues advisories and warnings for the aviation community. NOAA also runs computer simulations to forecast the dispersion of volcanic ash. NOAA, the U.S. Geological Survey (USGS), and the Federal Aviation Administration (FAA) work in a strong partnership to monitor and mitigate the effects of volcanoes on aviation.

There are over 100 historically active volcanoes across Alaska, the Kamchatka territory of Russia, and the Northern Kurile Islands that can affect U.S. airspace. Enhanced remote sensing systems, such as UAS, could be used to closely monitor these volcanoes and collect higher resolution real-time data in order to improve plume position forecasting. UAS could be useful in helping researchers and forecasters obtain data on the extent, composition, and density of ash plumes in Alaska. Ash extent data captured by sensors on UAS could be integrated into the operational forecast process and used to verify current volcanic ash detection techniques. Knowing ash density and composition would help improve ash fallout and dispersion forecasting and warnings. Sensors could also be released en-route to acquire wind speed and direction information.

Fisheries, Marine Mammals, and Sanctuaries Observations and Enforcement

NOAA's Office for Law Enforcement (OLE) helps protect and conserve our Nation's marine resources and their natural habitats along our coasts and within the U.S. Exclusive Economic Zone (EEZ). Our EEZ is the largest in the world spanning over 12,300 miles of coastline and contains 3.4 million square nautical miles of ocean—larger than the combined land mass of all 50 states. Alaska's coastlines alone are over 6,600 miles, and the task of monitoring and protecting this vast area is daunting.

OLE also provides direct enforcement support to a number of critical programs involving fisheries, endangered and threatened species, marine mammals, international commerce, and many other areas. For example, OLE and other Federal agencies protect the U.S. domestic fisheries industry, which has a national value close to $44.7 billion a year. Of this national total, one third represents Alaska's fisheries.

Traditional enforcement methods in Alaska involve deploying aircraft for surveillance and using various vessels for at-sea coverage. NOAA currently relies on significant support from the U.S. Coast Guard for these methods of surveillance, and UAS could supplement these resources in the execution of our regional enforcement strategies.

River Flood Monitoring and Forecasting

The mission of NOAA's Alaska River Forecast Center (AKRFC), part of the NWS, is to provide watches and warnings for flooding along all streams in Alaska. In addition to floods caused by rainfall or snowmelt, a common cause of flooding in Alaska is the breakup of ice jams. The AKRFC has monitored the breakup of rivers throughout Alaska for over two decades using field reconnaissance (including traditional aircraft) and observational networks (including satellites). While useful, these methodologies have their limitations. For example, given the vast size of Alaska, it is not possible to cover the entire territory using traditional aircraft surveys. Satellite-based information sometimes has to be scheduled 2 weeks ahead of time and requires clear skies. UAS could enhance NOAA's field reconnaissance capability, because of their increased flight autonomy and ability to directly downlink remote sense information.

Potential Roles of UAS in Hawaii

NOAA's work reaches to every corner of our nation, and the application of a UAS program could also extend to the Hawaiian Islands.

As an example, on June 15, President Bush designated the Northwestern Hawaiian Islands as a marine national monument. Encompassing nearly 140,000 square miles, the monument covers an area larger than all of our national parks put together. The creation of the largest marine conservation area in the world is an exciting achievement and recognizes the value of marine resources to our Nation.

The monument is one of the least accessible of our national treasures and presents ongoing challenges to ensure its monitoring, conservation, and protection. UAS based in Hawaii could take measurements of the monument and other Pacific Island regions that are too remote for most sustained manned aircraft observations. UAS have potential to address a number of additional issues in the Pacific including detection of marine debris, monitoring coral reef bleaching, and supplementing our national climate and weather prediction models.

The Challenges Ahead

NOAA has learned a great deal about the potential uses of UAS, their capabilities, and the ways in which they could help us meet challenges, create solutions, and produce results. Despite the potential for expanded observational capability that UAS represent in Alaska and other parts of the nation, a number of significant challenges remain, including platform cost and how best to integrate UAS into existing systems.

By virtue of development of UAS for military purposes, the United States has a commanding lead in UAS technology. As the technological maturity of UAS continues to increase, UAS have the potential to become a lower cost alternative to traditional research and operational missions. We will continue to explore the most cost-effective strategies to meet our mission goals and responsibilities.

The costs of purchasing a UAS range from less than fifty thousand dollars to tens of millions of dollars depending upon the desired aircraft performance requirements, such as range, duration, payload, altitude, and the sensors onboard. As described in a recent NASA report to Congress (*Potential Use of Unmanned Aircraft Systems (UAS) for NASA Science Missions*), the 2004 NASA commissioned study, *Cost and Business Model Analysis for Civilian UAS Missions,* found that "for the foreseeable future, the cost-per-hour-per-pound-of-payload will be at least an order of magnitude larger for a UAS when compared to a conventional manned aircraft." This additional cost may be reasonable, if the platform gathers data not otherwise accessible by manned aircraft because of safety concerns or aircraft performance limitations. UAS-based missions are not likely to replace traditional manned aircraft missions in the near future, but will instead complement and enhance them by providing unique datasets.

Concluding Remarks

NOAA constantly seeks better and more cost-effective ways to accomplish its mission for the Nation as we work to understand and predict changes in the Earth's environment. Through our NOAA Observing Systems Council and other related NOAA Councils, we continue to work toward coordinating observational and data management activities across NOAA; proposing priorities and investment strategies for observation related initiatives; and identifying programs that might benefit most from integration. UAS are an example of the emerging technologies NOAA is exploring that have the potential to alter how we monitor and respond to changes in the Earth's environment, much like radar and satellites did in the 1950s and 1960s. NOAA will continue to examine how UAS, and other emerging technologies, could assist us as we develop our daily weather forecasts, manage our Nation's marine resources, and research the changes occurring in our climate.

Mr. Chairman, I am happy to answer any questions that you, or other members of the Committee, may have.

The CHAIRMAN. We will now go to John Madden, Department of Homeland Security.

STATEMENT OF JOHN W. MADDEN, DEPUTY DIRECTOR, HOMELAND SECURITY, DIVISION OF HOMELAND SECURITY AND EMERGENCY MANAGEMENT, DEPARTMENT OF MILITARY AND VETERANS AFFAIRS, STATE OF ALASKA

Mr. MADDEN. Thank you, Mr. Chairman and members of the Committee, for inviting me to present testimony on the concept of unmanned aerial systems in Alaska and the Pacific Region. I am the Deputy Director for Homeland Security for the State of Alaska, but previously I did work for the Federal Aviation Administration, for the National Weather Service and also worked on the Joint Cruise Missile Project during my Federal career.

I learned of the NOAA initiatives about a year ago in which they wanted to conduct flights over the Arctic to improve their observations. On April 18 of this year, the State of Alaska hosted an open workshop on unmanned aerial systems. There were 55 attendees from 34 Federal and State agencies, as well as private sector companies and some non-profit organizations. We exchanged information on current UAS activities and technology around the world and identified potential uses of unmanned aircraft vehicles and systems in Alaska. Some potential missions recurring through the workshop included as my associate said, Arctic climate and weather research, ecosystems, habitat, volcanoes and wildfire aid, but also as an emergency communications platform, monitoring of critical infrastructure and search and rescue.

I will leave it to my associates in NOAA to describe the scientific missions within Alaska, but I emphasize whatever conditions NOAA detects and whatever predictions arise from their improved climate models, Alaska and its people, its economy and its culture, will be affected first.

A significantly large amount of critical infrastructure in Alaska is located in remote areas. This infrastructure is critical not only to the people and economy of Alaska, but to the Nation and we Alaskans take this charge very seriously and devote a significant amount of state, local and corporate resources to deter, detect and defend against all hazards and threats.

Through the coordinated use of unmanned aerial systems, we could radically improve our ability to integrate all of these protective activities and eliminate any gaps, seams and overlaps in security.

It is in the area of fire management in which the diversity of UAS missions is dramatically demonstrated. I foresee a fleet of unmanned aerial systems providing support. High altitude providing the perimeters of a fire and identifying the hot spots, a medium altitude providing a communications platform independent of the terrain and a lower level dropping sondes to improve the weather prediction.

River ice and flooding are recurrent problems within Alaska. Each spring as the ice begins to break up, dozens of river communities endure the uncertainty if or when they may be flooded. During the Yukon River breakup of May 2006, 150 miles of ice flowed down the Yukon with the potential of blocking the river at any turn and flooding several communities. The river watch program of the National Weather Service in NOAA in the State of Alaska, flew small, piloted aircraft at low speed, low altitude at great risk to monitor and assess the ice.

Unmanned aerial systems could gain situational awareness of the water conditions and the rapidly changing predictions and provide this information to the Federal and State entities responsible for protecting the people.

To accommodate the wide range of aircraft and missions, I envision an operations center at one of the hundreds of State-owned airports in Alaska. The center has hangar and maintenance space for the aircraft along with a test area for the payload equipment and technology. Near the aircraft base is a center for communications, information processing, logistical, and administrative support for a range of clients—Federal agencies, State academia and industry all linked together through a high-speed network of communications.

There could be accommodations for the actively participating organizations, as well as observers from the private sector, other states, Federal agencies and nations. Most importantly, the center is governed by a doctrine that's jointly developed that describes how priorities are set and how business is conducted. Through this governance, the participating agencies decide under what conditions to sacrifice a day of science to conduct a search and rescue, or what conditions to delay a wildlife census to monitor a threatening volcano.

I will now describe a potential flight and mission plan for an unmanned aerial system within Alaska. While it is unlikely that a single flight will ever perform all of these on one flight, this hypothetical flight contains several mission elements starting with a long-range unmanned aerial vehicle launch from a base in Alaska with a primary mission to make observations in the Arctic.

The aircraft quickly climbs through the general aviation operating altitudes and heads north on its programmed flight. It flies over the Trans Alaska Pipeline System, pump stations and river crossings and this information is relayed to the appropriate security centers.

It flies over Ft. Greeley and the national missile defense system to monitor for unauthorized access. En route it receives a report from the Alaska State Troopers of a missing boat on the Yukon River. The center quickly re-routes the aircraft to follow the river and relays that imagery to the Alaska State Troopers.

Over the North Slope, the aircraft collects imagery of a caribou herd for several Federal and State agencies, as well as universities researching the wildlife of that area. The image is retained on board for further forwarding.

It conducts its mission over the Arctic and on its return flies over the pipeline and rail and other areas, again from monitoring the critical infrastructure. It also can fly through the military special use airspace around Fairbanks to simulate an aircraft diverting from flight plan. This is a highly realistic test for the FAA and NORAD to detect, identify and intercept aircraft under these conditions.

I anticipate that the aviation community in Alaska may raise safety concerns about sharing airspace with unmanned aircraft. Alaska is the ideal venue to develop and test the standards for ensuring the safety of integrating UAS into the National Airspace System. While the per capita numbers of active pilots and registered aircraft in Alaska are the highest in the nation, there is still a great amount of airspace in Alaska. For example, there are as many registered aircraft in Alaska as in Ohio or Washington State, states with more population centers, fewer landing facilities and more controlled airspace.

It is often said and I agree that aviation is the lifeblood of Alaska more so than any other state. Alaskans know and greatly appreciate the improvements in recent years in aviation safety and security and the collaboration between FAA, the aviation industry and associations and the flying public is innovative, inclusive, and incredibly successful.

Aviation safety is and will remain vital to the state and worthy of the focus and resources afforded it. But it is not enough to be safe while in flight as other imminent dangers, fires, floods, volcanoes, coastal and river erosion and terrorism face our families and our communities. The aviation community is a critical component of Alaskan life and it is critical to the thoughtful examination and implementation of UAS technology in Alaska and across the Nation.

I have come up with a theme with UAS in Alaska and the Nation called "science, safety and security." There is a fourth part of that which is sales. For the emerging, unmanned aerial system industry in the United States to establish itself in the national and the world market, it must demonstrate reliable technology that meets business needs and Government missions and that operates in the widest range of environmental conditions and with logistical support. Alaska is the right location for such a testbed because there is more of the world like Alaska than many parts of the United States.

In conclusion, my foremost duty is to provide for the safety and security of the people of Alaska. This UAS initiative will significantly contribute to that end. Just as importantly, I believe that a civilian testbed in Alaska also serves the best interests of other states and the Nation as a whole. Only in Alaska can we test the full range of potential missions of UAS without immediately confronting the complex airspace found in most of the rest of the country. Only in Alaska can UAS be used to maximum efficiency through one flight conducting many missions, and I thank the Committee for this and this concludes my prepared remarks and I stand ready to answer any questions.

[The prepared statement of Mr. Madden follows:]

PREPARED STATEMENT OF JOHN W. MADDEN, DEPUTY DIRECTOR, HOMELAND SECURITY, DIVISION OF HOMELAND SECURITY AND EMERGENCY MANAGEMENT, DEPARTMENT OF MILITARY AND VETERANS AFFAIRS, STATE OF ALASKA

Introduction

Thank you, Mr. Chairman and members of the Committee, for inviting me to present testimony on the potential use of unmanned aerial systems (UAS) in Alaska and the Pacific Region. I am the Deputy Director for Homeland Security for the State of Alaska and have held this position since September of 2005. Before beginning my service to the State of Alaska, I served 37 years in seven Federal agencies, most recently three years with the Department of Homeland Security and Transportation Security Administration in Alaska. For eleven years before that, I worked with the Alaskan Region of Federal Aviation Administration (FAA). I also worked nine years with the Alaska Region of the National Weather Service and National Oceanic and Atmospheric Administration (NOAA).

Before transferring to Alaska from Washington, D.C. in 1982, I served with the headquarters of the Department of Energy working on fossil fuels research, the Joint Cruise Missile Project of the U.S. Navy and U.S. Air Force, several major defense programs, and on active duty with the U.S. Army in Vietnam and Washington, D.C.

With my experience in Federal and state agencies with missions supporting science, safety, and security, I am in a position to analyze and describe the UAS initiative with a well rounded view.

Initial Concepts

In October 2005, I first learned of NOAA's interest in UAS in Alaska to conduct long-term climate research in the Arctic. I understood their objective to be regular and frequent flights over the Arctic Ocean taking atmospheric and other scientific measurements to improve the climate prediction models.

I immediately saw a possible dual mission for these flights. During the flights to and from the Arctic, the aircraft could monitor the critical infrastructure of the Trans Alaska Pipeline System (TAPS), the oil production fields of the North Slope, refineries, oil storage facilities, and the Alaska Railroad. There was clearly a potential for one flight to accomplish two missions.

As I discussed this possibility with other state agencies and our Federal partners, I realized that the range of potential missions was far broader than first evident. There was a clear need to examine the possibility of unmanned aerial systems achieving many missions on one flight—for science, safety, and security. Also, it was evident that while several organizations were interested in UAS, there was no forum for formal discussions and examination of the technology.

Workshop on Unmanned Aerial Systems in Alaska

On April 18, 2006, the State of Alaska hosted an open workshop on unmanned aerial systems. The 55 attendees represented 34 Federal and state agencies, universities, private sector companies, and non-profit organizations. At the workshop, we exchanged information on current UAS activities and technology around the world and identified potential uses of unmanned aircraft vehicles and systems in Alaska. There was a strong emphasis on the possibility of Alaska as a testbed for UAS technology and applications that may prove beneficial to the entire Nation across a broad range of public service missions.

The attendees at the UAS workshop identified many potential mission areas broadly aligned along the themes of science, safety, and security. Some potential missions recurring during the workshop included Arctic climate and weather research, ecosystems and wildlife habitat, monitoring volcanoes and wildfires, emergency communications platform, monitoring of critical infrastructure, fisheries enforcement, emergency response management, and search and rescue. These are representative of the missions that, on first examination, seem incongruent and incompatible. However, we found these missions shared three common elements:

- UAS could improve the effectiveness of achieving the mission of each agency;
- an integrated UAS program would likely reduce the costs of many aspects of the individual missions; and
- UAS could reduce the risks to flight crews and aircraft often operating in very hazardous conditions.

Undoubtedly, there are several lists of potential mission areas prepared by other organizations. These lists should be seen as complementary rather than competitive. The civilian UAS industry is a new field and the ideas are emerging rapidly from many quarters. It is too soon to definitively include or exclude any single idea. Rather, that should be left for a later, more detailed review and planning process.

To describe each potential mission would require testimony of several hundred pages. As an expedient, I will describe a few areas that illustrate the range and diversity of missions. While I describe these missions from an Alaskan perspective, the conditions and challenges in Alaska will replicate those found in other states and regions throughout the country.

- Arctic Climate and Weather Research—I leave it to my associates from NOAA to describe the scientific missions for UAS in Alaska. However, I emphasize that whatever conditions NOAA detects and whatever predictions arise from improved climate models, Alaska—its people, economy, and culture—will be affected first. This mission, as I understand it, requires a platform with intercontinental range, sensing packages, and delivery systems for sondes.

- Monitoring of Critical Infrastructure—A significantly large amount of critical infrastructure in Alaska is located in remote areas. This infrastructure is critical to the people and economy of Alaska and the Nation. We Alaskans take this charge very seriously. We devote a significant amount of state, local and corporate resources to deter, detect, and defend against all hazards and threats. To protect just the energy sector—power generation and distribution, oil and gas production fields, pipeline, pump stations, refineries, rail transport, and storage facilities—there are more than two dozen federal, state, and local agencies and private sector corporations providing some piece of the overall protection. Through the coordinated use of UAS, we could radically improve our ability to integrate all these protective activities and eliminate any gaps, seams, or overlaps in the security. To meet this mission, a variety of aircraft platforms would be needed.
- Fire Management and Response—In this area the diversity of UAS technology and missions is dramatically demonstrated. The rapidly changing nature of firefighting, constantly shifting and always threatening, is extremely challenging to the firefighters and those supporting them. In some future fire scenario, there will be an integrated use of specialized unmanned aerial systems. A high altitude platform continually captures the perimeter, damage, and direction of all fires within range and locates the hotspots within the fire. This information is transmitted real-time to the incident commander who develops and refines the strategy and tactics for the entire fire area. A medium altitude aircraft serves as an airborne radio communications base to ensure every element is in constant contact despite the terrain or ground based stations. A medium to low flying platform drops weather sondes around the fire for atmospheric readings critical to extremely accurate weather predictions down to the range of one kilometer. In the past two years, Alaska has lost more than 11 million acres to wildfires—as much as the rest of the Nation combined. There will be no shortage of opportunities to test technology, tactics, and techniques in Alaska that will be immediately useful to other states with wildfires.
- Volcano monitoring—Alaska has about 40 volcanoes active in historical times. As recently as January of this year, Mt. Augustine threatened communities along Cook Inlet and the air routes over the Northern Pacific. In recent years, other eruptions from Mt. Spurr, Mt. Redoubt, and Mt. Augustine, disrupted commercial aircraft operations throughout the Pacific and half the country. While NOAA, the FAA, and the Alaska Volcano Observatory have greatly improved their ability to monitor and predict the movement of ash clouds, other information remains difficult to obtain. During the UAS Workshop, there was speculation on the use of small, low-cost, sacrificial unmanned aerial vehicles to fly into volcanic ash clouds to gather and transmit information on the chemical composition and size of the particulate. Also, it would be of significant value to have an unmanned aircraft remain on station for hours or days to monitor and transmit visual and infrared information from the volcano. Again, a variety of unmanned aerial vehicles would supplement the ground and satellite based monitoring resources.
- River Ice and Flooding—Each spring as the ice on the Alaskan rivers begin to break up, dozens of river communities endure the uncertainty of if or when they may be flooded. During the Yukon River breakup in May 2006—150 miles of ice traveled downriver with the potential of blocking the river at any turn and flooding several communities. The river watch program of the National Weather Service and the State of Alaska flew small, piloted aircraft at slow speed and low elevation to monitor and assess the ice. This approach places pilot and crew at great personal risk and cannot stay on station for long. Similar conditions of seasonal flooding exist throughout the country. The process of gaining situational awareness of water conditions and rapidly identifying changes to predictions could immediately be exported to other states and regions.

Model for the Civilian UAS Testbed and Operations Center in Alaska

It was evident from discussions during and since the April workshop that no single type of UAS could meet all these missions. Rather, the ideal UAS test program would include several platform types—from the high altitude, long endurance aircraft requiring a long runway to very small aircraft capable of low and slow flight, launched pneumatically or by hand, and easily deployed. Also, the UAS initiative is more than the vehicles and technology. The unmanned aircraft are essentially tools to acquire data and information for the other elements of the system to analyze and distribute.

To accommodate this wide range of aircraft and missions, I envision an operations center at one of the hundreds of State owned airports. The center is operated by a Federal government agency or contractor. The center has hangar and maintenance space for the aircraft along with a test area for assembly, test, fabrication, and modification of payload equipment and technology. Near the aircraft base is the center for communications, information processing, logistical, and administrative support for a range of clients—government, academia, and industry. The operations center is linked to the clients in Alaska and throughout the Nation via high-speed, broadband fiber optic and satellite network. The center has sufficient computing power for processing, analysis, and archiving huge amounts of data and imagery. The center provides for the maximized productivity of each flight hour by aligning missions, equipment, sensing packages, and priorities from clients. Further, the center would safeguard the information from unauthorized access and use.

Depending on the missions, there may be UAS forward deployed to other locations during seasonal events such as flooding, fire, wildlife migration, fisheries seasons, and breakup of river ice. There would be accommodations for the actively participating organizations as well as observers (real or virtual) from the private sector, other states, Federal agencies, and even nations. These observers could learn first hand the UAS operations relevant to their needs and plans. Each could then make informed recommendations and decisions on the transfer of the UAS technology and procedures to their constituency or organization.

The center is governed by a charter that broadly prescribes how priorities are set, how conflicts are resolved, and how business is conducted. Through this governance, the participating agencies and organizations decide under what conditions to sacrifice a day of scientific observations to conduct a search and rescue operation or under what conditions to delay a wildlife census to monitor a threatening volcano.

Profile of One Flight With Many Missions

I will describe the flight and mission plan for one flight of an unmanned aerial vehicle should this initiative be realized. While it is unlikely that a single flight will ever perform all of these, this hypothetical flight contains several mission elements that, individually, would be extremely difficult, dangerous, or expensive with manned aircraft or through satellite observations.

1. A long-range unmanned aerial vehicle launches from a base in Southcentral Alaska with its primary mission to drop weather sondes over the Arctic Ocean. It is also equipped with optical and infrared sensors to accomplish several secondary missions along the way.

2. The aircraft quickly climbs above the general aviation operating altitudes and heads north on its programmed flight.

3. As scheduled, the aircraft flies over the Trans Alaska Pipeline System, the pump stations and river crossings. The imagery is relayed through a high-speed, secure downlink to the pipeline security operations center.

4. The aircraft also flies over Ft. Greeley and the national missile defense base. The imagery is relayed to security forces.

5. The UAS Operations Center receives a report from Alaska State Troopers of a boat overdue from a trip on the Yukon River from Circle to Fort Yukon. The aircraft is directed to divert slightly to follow and monitor the Yukon River. The aircraft collects the imagery and transmits it to the UAS Control Center. The center quickly analyzes the imagery and relays to the Alaska State Troopers the locations of the most likely search areas. The search by manned aircraft is now more focused and effective.

6. Over the North Slope, the aircraft begins collecting imagery of a caribou herd for several Federal and state agencies as well as universities researching the wildlife of that area. The imagery is retained onboard the aircraft for later forwarding to the client agencies and universities.

7. As the aircraft approaches the Arctic Ocean, it flies a scheduled path over the oil fields at Prudhoe Bay and takes optical and infrared images to detect hotspots indicative of leaks and the surrounding areas for unauthorized people and vehicles. The imagery is relayed real time to the pipeline operations center.

8. Over the next several hours, the aircraft conducts its primary mission of atmospheric observations over a large swath of the Arctic Ocean.

9. On its return to the mainland, the aircraft follows the flight plan along the pipeline from Prudhoe Bay to Fairbanks, again concentrating on pump stations, river crossings, and other critical elements. It relays imagery in real-time to the pipeline operations center.

10. The UAS Operations Center receives a report from the Alaska Rescue Coordination Center (RCC) in Anchorage of an emergency locator transmitter detected near Chandalar Lake in the Brooks Range above the Arctic Circle. The Control Center recalls a portion of the imagery already collected for pipeline security and reroutes it to the RCC for analysis and action.

11. The aircraft flies a planned route through the military special-use airspace near Fairbanks to simulate a commercial aircraft deviating from flight plan. This provides a highly realistic test for the FAA and the North American Aerospace Defense Command to detect, identify, and intercept an aircraft under these conditions.

12. The flight plan includes a scheduled reconnaissance flight over an active fire area near Nenana. The infrared and optical imagery of the fires is relayed real-time to the Alaska Fire Service in Fairbanks who matches it with information from other UAS on low-level flights.

13. The aircraft continues southward above the Alaska Railroad and monitors the remote rail bridges before the transport of a large shipment of highly hazardous materials. The imagery is sent real time to the railroad operations center.

14. The aircraft completes its one flight and its many missions and returns to base. The imagery, atmospheric observations, and other data are downloaded for archiving, distribution, and analysis.

Aviation Safety

I anticipate that the aviation community in Alaska may raise safety concerns about sharing airspace with unmanned aircraft. Alaska is the ideal venue to develop and test the standards for ensuring the safety of integrating UAS into the National Airspace System. While the per capita numbers of active pilots and registered aircraft in Alaska are the highest in the nation, there is still a great amount of airspace in Alaska. According to FAA records, there were about the same number of active pilot certificates in Alaska as in Maryland or Massachusetts, states with significantly larger populations but much smaller land area and airspace.

Also, Alaska has about the same number of registered aircraft—private, corporate, and commercial—as Ohio or Washington State, states with more population centers, fewer landing facilities, and more controlled airspace. I understand there are many other factors such as number of flights, distance and duration of flights, controlled and uncontrolled airspace, weather and radar coverage, and the limited road system. However, the risks of flying in Alaska are widely recognized and increasingly well documented.

It is often said, and I agree, that aviation is the lifeblood of Alaska—more so than any other state. Alaskans know and greatly appreciate the improvements in recent years in aviation safety and security. The collaboration between FAA, the aviation industry and associations, and the flying public is innovative, inclusive, and incredibly successful. The most notable programs in recent years are the Capstone program, the Medallion Foundation, the Circle of Safety, and the statewide system of weather cameras.

Aviation safety is and will remain vital to the state and worthy of the focus and resources afforded it. But there is strong need for the aviation community to collaborate on this initiative to confront other hazards that are just as threatening to our citizens. It is not enough to be safe while in flight as other imminent dangers—fires, floods, volcanoes, coastal and river erosion, terrorism—face our families and communities. The aviation community is a critical component of Alaskan life and it is critical to the thoughtful examination and implementation of UAS technology and operations in Alaska and across the Nation.

Benefits to the Nation From a UAS Testbed and Operations Center in Alaska

A civilian UAS operations center in Alaska will facilitate the methodical testing and evaluation of existing and emerging technologies in challenging field conditions. It also is the perfect laboratory to find the best means and timetable for introducing unmanned aerial systems into the National Airspace System.

For the emerging UAS industry in the United States to establish itself in the world market, it must demonstrate reliable technology that meets business needs and government missions, and that operates in the widest range of environmental conditions, and with logistical support. Alaska is the right location for such a testbed because there is more of the world like Alaska than many parts of the United States.

Conclusion

My foremost duty is to provide for the safety and security for the people and economy of Alaska. The UAS initiative will significantly contribute to a safer and more secure Alaska. Just as importantly, I believe that a civilian testbed in Alaska also serves the best interests of other states and the Nation as a whole. Only in Alaska can we test the full range of potential missions of UAS without immediately confronting the complex airspace found in most of the National Airspace System. Only in Alaska can UAS be used to maximum efficiency through one flight conducting many missions—on each flight. Only in Alaska can the unmanned aerial system initiative be subjected to the most demanding climactic, environmental, logistical, and administrative challenges without dooming it to early and avoidable failure.

This concludes my prepared remarks. I stand ready to answer any questions you, or other members of the Committee, may have.

The CHAIRMAN. Next witness is Nick Sabatini, Associate Administrator for Safety of the FAA.

STATEMENT OF NICK SABATINI, ASSOCIATE ADMINISTRATOR FOR AVIATION SAFETY, FEDERAL AVIATION ADMINISTATION (FAA)

Mr. SABATINI. Thank you Mr. Chairman. I am pleased to appear before you today to discuss the subject that serves to remind us that future is now. The development and use of unmanned aircraft systems, UAS is the common acronym, is the next great step forward in the evolution of aviation. As it has throughout its history, FAA is prepared to work with other government agencies and industry to ensure that these aircraft are both safe to operate and are operated safely. The extremely broad range and complexities of UAS makes their successful integration into the national airspace system a challenge, but certainly one worth meeting.

At the outset, you must understand that UAS cannot be described as a single type of aircraft. UAS can be vehicles that range from a 12-ounce hand-launched model to the size of a 737 aircraft. They also encompass a broad span of altitude and endurance capabilities. Obviously, the size of the UAS impacts the complexity of its system design and compatibility. Therefore, each different type of UAS has to be evaluated separately. Interest in using UAS for a range of very different purposes is increasing, not only by the Department and agencies represented by my colleagues here today, but also by DOD, NASA and state and local governments. As you may know, any aircraft operated by government agencies, including a UAS is considered a public aircraft operation. Consequently, the oversight and certification of that aircraft is the responsibility of that public agency. These public operations are however required to be in compliance with certain basic Federal aviation regulations set by the FAA, especially those that ensure that the operation of these aircraft does not compromise safety. FAA's current role is to ensure that UAS do no harm to other operators in the aviation system and to the maximum extent possible, the public on the ground.

If an agency seeks to operate a UAS, FAA works with them to develop conditions and limitations for UAS operations to ensure that they do not jeopardize the safety of other aviation operations. We issue what is known as a Certificate of Authorization or COA, with terms that ensure an equivalent level of safety as manned aircraft. Usually, this entails making sure that the UAS does not operate in a populated area and that the aircraft is observed either by someone in a manned aircraft or someone on the ground.

For example, the FAA has worked with Homeland Security to facilitate UAS operations along the Arizona-New Mexico border with Mexico. In order to permit such operations, we segregated the airspace so these UAS flights could operate without an observer being physically present to observe the operation. Also, last year we worked with NOAA to approve a COA that allowed atmospheric testing using a UAS for operations to take place over the Channel Islands, off of the coast of California. It was a unique operation that required the flexibility to climb and descend randomly between 1,000 feet and 12,000 feet as needed for mission success.

In addition to those certificates, we issued a COA to the Coast Guard for a UAS mission that operated from King Salmon, Alaska. That mission consisted of flights along the U.S. and Russian Maritime Boundary Line, the 100 fathom curve in the Bering Sea, and in the High Sea Driftnet area south of the Aleutian Island chain. There was also a provision to conduct a fly-over the Alaska pipeline. I should also note that to assist in preparedness such as severe hurricanes, in May we issued a Certificate of Authorization to DOD that specifically allows deployment of Global Hawk or Predator UAS to a disaster area. Each of these operations require extensive coordination and effort with the steadily expanding purposes for which UAS are used and the eventual stateside redeployment of large numbers of UAS from the theater of war, the FAA expects to issue a record number of COAs. In fact, the FAA has issued over 55 COAs this year alone, compared with a total of 50 for the two previous years combined.

FAA's work with private industry is slightly different. Companies must obtain an airworthiness certificate by demonstrating that their aircraft can operate safely within an assigned flight test area and cause no harm to the public. This is documented by the applicant in what we call a program letter. After detailed analysis and onsite review by FAA experts and if operating limitations are worked out, FAA will accept the application for an experimental and airworthiness certificate. So far we have received 14 program letters for UAS ranging from 39 to over 10,000 pounds and we have issued two experimental airworthiness certificates, one for General Atomics' Altair, and one for Bell–Textron's Eagle Eye. We expect to issue at least two more experimental certificates this year.

The COA and Experimental Airworthiness Certificate processes are designed to allow a sufficiently restricted operation to ensure a safe environment while allowing for research and development until such time as pertinent standards are developed. They allow the FAA, other government agencies and private industry to gather valuable data about a largely unknown field of aviation. The development of standards is crucial to moving forward with UAS integration in the NAS. FAA has tasked the RTCA with the development of a Minimum Operational Performance Standard for sense and avoid, and command and control and communication. These standards will allow manufacturers to begin to build certifiable avionics for the U.S. and expect that they will take at least three to 4 years to develop. Currently there is no recognized technology solution that could make these aircraft capable of meeting regulatory requirements for see and avoid, command and control.

Further, some unmanned aircraft will likely never receive unrestricted access to the NAS due to the limited amount of avionics it can carry because of weight such as transponders that can be installed in a vehicle itself weighing just a few ounces. Likewise, the performance difference with surrounding air traffic can present challenges. Some UASs operate an airspace used primarily by jet aircraft that can fly at more than twice their speed, thus complicating the control of the airspace. FAA is fully cognizant that UASs are becoming more and more important to more and more Government agencies and private industry. The full extent of how they can be used and what benefits they can provide are still being explored. Over the next several years when RTCA has provided recommended standards to the FAA, we will be in a position to provide more exact certification and operational requirements to UAS operators.

As the technology gap closes, we expect some UASs will be shown to be safer and have more access to the NAS.

The future of avionics and air traffic control contemplates aircraft communicating directly with one another to share information to maximize the efficiency of the airspace. This certainly could include some models of UAS. Just as there is a broad range of UASs, there will be a broad range of ways to safely provide them access to the NAS.

Our commitment is to make sure that when they operate in the NAS, they do so with no degradation of system safety.

Mr. Chairman, in our history, FAA and its predecessor agencies have successfully transitioned many new and revolutionary aircraft types and systems into the NAS. FAA is prepared to meet the challenges that UAS present. We will continue to work closely with our partners in Government, industry and Congress, to ensure that the national airspace system has the ability to take maximum advantage of the unique capabilities of unmanned aircraft.

This concludes my prepared remarks, and I'll be happy to answer any questions.

[The prepared statement of Mr. Sabatini follows:]

PREPARED STATEMENT OF NICK SABATINI, ASSOCIATE ADMINISTRATOR FOR AVIATION SAFETY, FEDERAL AVIATION ADMINISTRATION (FAA)

Chairman Stevens, Co-Chairman Inouye, members of the Committee. I am pleased to appear before you today to discuss a subject that serves to remind us that the future is now. The development and use of unmanned aircraft systems (UAS) is the next great step forward in the evolution of aviation. As it has throughout its history, FAA is prepared to work with other government agencies and industry to ensure that these aircraft are both safe to operate and are operated safely. The extremely broad range of UAS makes their successful integration into the national airspace system (NAS) a challenge, but certainly one worth meeting. To meet this vital need, the FAA has established an Unmanned Aircraft Program Office which has the expressed purpose of ensuring a safe integration of UAS into the NAS.

At the outset, you must understand that UAS cannot be described as a single type of aircraft. UAS can be vehicles that range from a 12-ounce hand-launched model to the size of a 737 aircraft. They also encompass a broad span of altitude and endurance capabilities. Obviously, the size of the UAS impacts the complexity of its system design and capability. Therefore, each different type of UAS has to be evaluated separately, with each aircraft's unique characteristics being considered before its integration into the NAS can be accomplished. FAA is currently working with both other government agencies and private industry on the development and use of UAS.

Today's hearing is another indicator that the number of government agencies wanting to explore the use of UAS in support of their mandate is on the rise. In addition to the Departments of Defense (DOD) and Homeland Security (DHS), the Department of the Interior (DOI), the National Oceanic and Atmospheric Administration (NOAA), the National Aeronautics and Space Administration (NASA) and state and local governments are all interested in increasing their use of UAS for a range of very different purposes. Any aircraft operated by government agencies in the NAS, including a UAS, is considered a public aircraft operation and the oversight and certification of that aircraft is the responsibility of the relevant Federal agency. These public operations are, however, required to be in compliance with certain Federal aviation regulations administered by the FAA, especially those that ensure that the operation of these aircraft does not compromise the safety of the NAS. FAA's current role is to ensure that UAS do no harm to other operators in the NAS and, to the maximum extent possible, the public on the ground.

In working with government agencies, the FAA issues a Certificate of Authorization (COA) that permits the agency to operate a particular UAS for a particular purpose in a particular area. In other words, FAA works with the agency to develop conditions and limitations for UAS operations to ensure they do not jeopardize the safety of other aviation operations. The objective is to issue a COA with terms that ensure an equivalent level of safety as manned aircraft. Usually, this entails making sure that the UAS does not operate in a populated area and that the aircraft is observed, either by someone in a manned aircraft or someone on the ground. In the interest of national security the FAA worked with DHS to facilitate UAS operations along the Arizona/New Mexico border with Mexico. In order to permit such operations, the airspace was segregated to ensure system safety so these UAS flights can operate without an observer being physically present to observe the operation. In addition, the FAA worked with NOAA in 2005 to approve a COA that allowed atmospheric testing using a UAS to take place over the Channel Islands, off of the coast of California. It was a unique operation that required the flexibility to climb and descend randomly between 1,000 feet and 12,000 feet as needed for mission success. In June 2004, FAA issued a COA to the United States Coast Guard for a UAS mission that operated from King Salmon, AK. This mission consisted of flights along the United States and Russia Maritime Boundary Line, the 100-fathom curve in the Bering Sea, and in the High Sea Driftnet Area south of the Aleutian Island chain. There was also a provision to conduct a fly-over of the Alaska pipeline. Each of these operations required extensive coordination and effort. With the steadily expanding purposes for which UAS are used and the eventual stateside redeployment of large numbers of UAS from the theater of war, the FAA expects to issue a record number of COAs. In fact, the FAA has issued over 55 COAs this year alone, compared with a total of 50 for the two previous years combined.

FAA's work with private industry is slightly different. Companies must obtain an airworthiness certificate by demonstrating that their aircraft can operate safely within an assigned flight test area and cause no harm to the public. They must be able to describe their unmanned aircraft system, along with how and where they intend to fly. This is documented by the applicant in what we call a program letter. An FAA team of subject matter experts reviews the program letter and, if the project is feasible, performs an on-site review of the ground system and unmanned aircraft, if available. If the results of the on-site review are acceptable, there are negotiations on operating limitations. After the necessary limitations are accepted, FAA will accept an application for an Experimental Airworthiness Certificate which is ultimately issued by the local FAA Manufacturing Inspection District Office. The certificate specifies the operating restrictions applicable to that aircraft. We have received 14 program letters for UAS ranging from 39 to over 10,000 pounds. We have issued two experimental certificates, one for General Atomics' Altair, and one for Bell-Textron's Eagle Eye. We expect to issue at least two more experimental certificates this year.

Each UAS FAA considers, whether it be developed by government or industry, must have numerous fail-safes for loss of link and system failures. Information must be provided to FAA that clearly establishes that the risk of injury to persons on the ground is highly unlikely in the event of failures or loss of link. Like everything else having to do with UAS, the methods that link the aircraft with ground control can be as simple as frequency line of sight or as complex as multiple ground and satellite paths making up a functional connection. If the link is lost, it means the aircraft is no longer flying under control of the pilot. Because FAA recognizes the seriousness of this situation, we are predominantly limiting UAS operations to unpopulated areas. Should loss of link occur, the pilot must immediately alert air traffic control and inform the controllers of the loss of control link. Information about what the aircraft is programmed to do and when it is programmed to do it is pre-coordinated with the affected air traffic control facilities in advance of the flight so that FAA can take the appropriate actions to mitigate the situation and preserve safety.

The COA and Experimental Airworthiness Certificate processes are designed to allow a sufficiently restricted operation to ensure a safe environment, while allowing for research and development until such time as pertinent standards are developed. They also allow the FAA, other government agencies, and private industry to gather valuable data about a largely unknown field of aviation. The development of standards is crucial to moving forward with UAS integration in the NAS. FAA has tasked the Radio Technical Commission for Aeronautics (RTCA), an industry-led Federal advisory committee to FAA, with the development of a Minimum Operational Performance Standard (MOPS) for sense and avoid, and command, control and communication. These standards will allow manufacturers to begin to build certifiable avionics for UAS. It is expected that the MOPS for avionics will take at least three to four years to develop. Until there are set standards and aircraft meet them, UAS will continue to have appropriate restrictions imposed. In addition, the FAA is working closely with DOD and DHS to collaborate on the appropriate approach to certification standards.

Because of the extraordinarily broad range of unmanned aircraft types and performance, the challenges of integrating them safely into the NAS continue to evolve. Urgent future ground surveillance needs must be balanced with ongoing air transportation operations. The certification and operational issues described herein highlight the fact that there is a missing link in terms of technology today that prevents these aircraft from getting unrestricted access to the NAS. Currently there is no recognized technology solution that could make these aircraft capable of meeting regulatory requirements for see and avoid, and command and control. Further, some unmanned aircraft will likely never receive unrestricted access to the NAS due to the limited amount of avionics it can carry because of weight, such as transponders, that can be installed in a vehicle itself weighing just a few ounces. Likewise, the performance difference with surrounding air traffic can present challenges. Some UAS operate in airspace used primarily by jet aircraft that can fly at twice their speed, thus complicating the control of the airspace.

FAA is fully cognizant that UAS are becoming more and more important to more and more government agencies and private industry. The full extent of how they can be used and what benefits they can provide are still being explored. Over the next several years, when RTCA has provided recommended standards to the FAA, we will be in a position to provide more exact certification and operational requirements to UAS operators. As the technology gap closes, we expect some UAS will be shown to be safer and have more access to the NAS. The future of avionics and air traffic control contemplates aircraft communicating directly with one another to share flight information to maximize the efficiency of the airspace. This could certainly include some models of UAS. Just as there is a broad range of UAS, there will be a broad range of ways to safely provide them access to the NAS. Our commitment is to make sure that when they operate in the NAS, they do so with no degradation of system safety.

The FAA has a long-standing history of working with the State of Alaska in the development of new technologies. A recent example of this is the Capstone program for which Alaska has been the proving ground of the Automatic Dependent Surveillance-Broadcast technology or ADS–B, a technology I know the Administrator spoke about at the recent field hearing in Alaska.

The FAA has other ongoing initiatives in Alaska. Starting in September 2005, the FAA tasked the University of Alaska, Anchorage and Fairbanks campuses, with participating in a research and development program through the FAA's Air Transportation Center of Excellence for General Aviation Research (CGAR). The CGAR is a consortium of academia, industry, and government that is ready to address the critical needs of general aviation through synergistic relationships. The University of Alaska has been teamed up with two other institutes to evaluate detect, sense and avoid systems, primarily through an extensive library search, that have a benefit to aviation safety. This project will build on the work already completed by University of Alaska Fairbanks (UAF) at the Poker Flats range located near Fairbanks, Alaska.

Another project assigned to the CGAR team involved with the University of Alaska is looking at the potential design and certification criteria of UAS with an emphasis on size, speed and impact energy limits as it relates to the safety of manned aircraft and persons and property on the ground. This project will again, build on the work already completed by UAF at the Institute of Northern Engineering and the Transportation Research Center. The University of Alaska already has airspace experience gained from UAS work conducted to/from, and within Alaska and will be working on other UAS projects in conjunction with this one.

In our history, FAA and its predecessor agencies have successfully transitioned many new and revolutionary aircraft types and systems into the NAS. Beginning in 1937, we completed the U.S. certification for the first large scale production airliner (the DC–3), then went on to certify the first pressurized airliner (the Boeing B–307 in 1940), civil helicopter (Bell 47 in 1946), turboprop (Vickers Viscount in 1955), turbojet (Boeing 707 in 1958), as well as the supersonic transport (Concorde in 1979), and the advance wide-body jets of today (Boeing 747–400 in 1989). It seems appropriate that, as we begin a new century and new millennium, advances in aviation technology present us with another addition to the fleet with great potential—unmanned aircraft.

Mr. Chairman, FAA is prepared to meet the challenge. We will continue to work closely with our partners in government, industry and Congress to ensure that the National Airspace System has the ability to take maximum advantage of the unique capabilities of unmanned aircraft.

This concludes my prepared remarks. I will be happy to answer your questions at this time.

The CHAIRMAN. Thank you very much. Our next witness is Rear Admiral Wayne Justice, Assistant Commandant for Response in the Coast Guard.

Admiral.

STATEMENT OF REAR ADMIRAL WAYNE JUSTICE, ASSISTANT COMMANDANT FOR RESPONSE, U.S. COAST GUARD

Admiral JUSTICE. Good afternoon Chairman, Co-Chairman, Inouye. It is my honor to be here today to discuss the future of Unmanned Aircraft Systems in the Coast Guard in protecting our maritime borders and ensuring our national security.

This an important issue because of the potential enhancements UASs bring to securing our maritime borders.

The Coast Guard is actively working with the FAA, Department of Defense, and CBP Air Marine Operations to implement viable plans in this emerging technology. In concert with a layered security construct attending to diverse and distant missions such as enforcing the maritime boundary line in the Bering Sea, restricting high seas drift net fishing throughout the Pacific or ensuring compliance for new regulations in the Northern Hawaiian monument is paramount. The current Coast Guard legacy manned maritime patrol aircraft fleet falls short of providing the targeted end state of 61,600 maritime patrolled aircraft hours per year. Under our Revised Deepwater Implementation Plan, the Coast Guard expects to close the gap with new Deepwater MPA platforms by the year 2016. Land-based UAS platforms are a key component of the MPA gap mitigation strategy.

The post-9/11 Deepwater Implementation Plan calls for the procurement of 45 VUAVs and the purchase of High Altitude Endurance Unmanned Aerial Vehicle sensor data utilizing land based, long endurance UASs.

The Eagle Eye VUAV is being developed to deploy on both National Security Cutters and Offshore Patrol Vessels. The System Assembly and Demonstration phase will begin soon, with the first flight planned for December 2008 and an Initial Operating Capability in 2012. The high altitude UAS is a land-based, wide area surveillance platform with a long endurance capability and is scheduled for initial implementation in 2016. The Coast Guard is also exploring the option of performing this mission with more versatile and less expensive alternatives such as the Medium Altitude Long Endurance platforms.

As previously mentioned the Coast Guard Research and Development Center led two major Alaskan concept demonstrations in November 2003 and July 2004. The 2003 Predator A evaluation provided the Coast Guard important information on the logistics of deploying UASs to remote areas and the information about the challenges of operating a UAS in adverse weather conditions.

July 2004 Altair concept demonstration focused on operations using Beyond-Line-of-Sight communications to control the aircraft and receive sensor data. The Altair aircraft was remotely piloted from a ground control station in San Diego during its transit along the West Coast to Alaska. Similar to the first test, weather proved to be the biggest challenge. Unfortunately, 10 of the 17 planned flights were canceled due to forecasted icing, low cloud ceilings and poor visibility on scene and at the airport. Less than optimal satellite coverage at the northern latitudes provided questionable command and control reliability.

There are three areas of concern the Coast Guard has relating to UAS flight safety: crew qualification, system airworthiness, and flight rules, especially collision and avoidance. Until new UAS regulations are adopted, the Coast Guard will utilize the FAA's Certificate of Waiver and Authorization, COAs, process to perform many testing evaluations or operations.

This process allows for limited scheduling of Coast Guard UAS operations in the national and international airspace.

That said the Coast Guard remains eager to work closely with out interagency partners to operationally test and evaluate UAS technologies in the maritime environment. While UASs are not suitable for all missions and have many distinct challenges, they do provide potentially effective and economical capabilities that could be force multipliers for our maritime domain surveillance and detection missions. The Coast Guard looks forward to building the expertise required to safely operate the UASs and to realize the potential as a wide area surveillance tool in the maritime environment.

Sir, thank you for the opportunity to appear before the Committee today, and I am happy to address any questions you may have.

[The prepared statement of Admiral Justice follows]:

PREPARED STATEMENT OF REAR ADMIRAL WAYNE JUSTICE, ASSISTANT COMMANDANT FOR RESPONSE, U.S. COAST GUARD

Good afternoon Mr. Chairman and distinguished members of the Committee. It is my pleasure to be here today to discuss the future of Unmanned Aircraft Systems (UAS) in protecting our maritime borders and ensuring our national security.

This is an important issue because of the potential enhancements that UASs bring to securing our maritime borders. The Coast Guard is keenly aware of the safety concerns surrounding UAS programs and is working with the Federal Aviation Administration (FAA), the Department of Defense (DOD), and Customs and Border Protection (CBP) Air and Marine to implement viable plans for this emerging technology.

Cutter-based Vertical Unmanned Aerial Vehicle (VUAV) and High Altitude Endurance Unmanned Aerial Vehicle (HAEUAV)

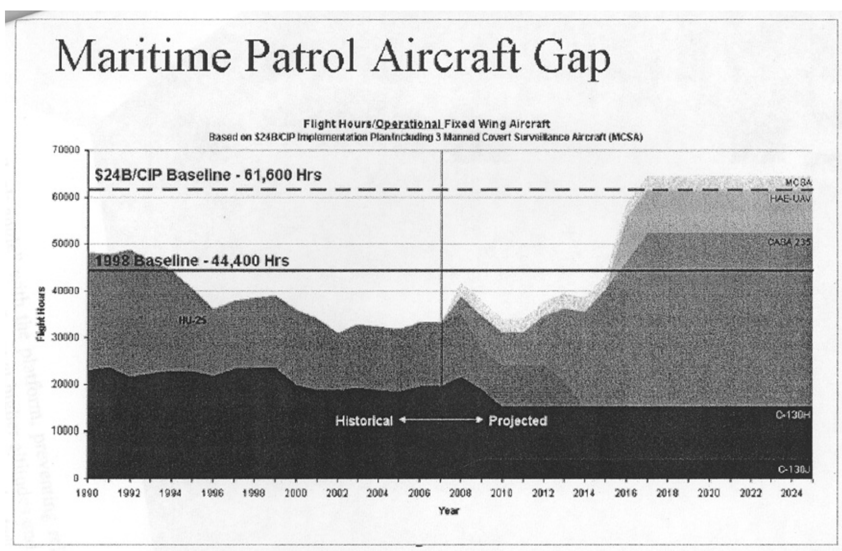
The post-9/11 Deepwater implementation plan calls for the procurement of 45 VUAVs and the purchase of High Altitude Endurance Unmanned Aerial Vehicle sensor data utilizing land based, long endurance UASs.

The Eagle Eye VUAV is being developed to deploy on both National Security Cutters and Offshore Patrol Cutters. The project is currently in the System Design and Development phase and will shortly begin the System Assembly and Demonstration phase, with the first flight planned for December 2008. Funding availability has pushed the delivery of the Initial Operating Capability (IOC) for the VUAV to approximately 2012. The VUAV will be a transformational tactical asset for the Coast Guard and will expand cutters' surveillance capabilities for the detection, classification, and identification of targets to a distance of 100 miles.

The high altitude UAS are a land based, wide area surveillance platforms with a long endurance/dwell time capability. The high altitude UAS are scheduled for initial implementation in 2016. The Coast Guard is also exploring the feasibility of performing this mission with more versatile and less expensive alternatives, such as Medium Altitude Long Endurance (MALE) platforms.

Using Unmanned Aircraft Systems to Help Close the Maritime Patrol Aircraft Gap

Figure 1 shows the existing Maritime Patrol Aircraft (MPA) gap. The current Coast Guard legacy manned MPA fleet falls short of providing the targeted end state of 61,600 MPA flight hours per year. Under the 1998 Revised Deepwater Implementation Plan, the Coast Guard expects to close the gap with new Deepwater MPA platforms by 2016. Note that UAS is a key component of the MPA gap mitigation strategy. With the capability to fly for more than 30 hours without refueling, these land based UASs have a significant on-scene persistence advantage over manned aircraft, resulting in a significant improvement of Coast Guard maritime domain awareness. However, I must emphasize the importance of proper sensorization, lest a high performance aircraft actually fail to meet mission requirements. Sensorization includes outfitting the aircraft with equipment to detect targets of interest (i.e. sensitive marine radars, electro optical infrared to see at night).



Operational Exercises in Alaska

The Coast Guard Research and Development Center led two major tests of a medium altitude long endurance UAS in Alaska. The first was a Predator A concept demonstration in November 2003, and the second was an Altair (Predator B variant) evaluation in July 2004.

The November 2003 test of the Predator A was the first-ever flight of a medium altitude long endurance UAS in the harsh Alaskan environment. The evaluation provided the Coast Guard with important information on the logistics of deploying UASs to remote areas and information about the challenges of operating a UAS in adverse weather conditions. Weather conditions including temperature, cloud cover, wind and precipitation were important variables during the operational tests. (Difficultly starting the vehicle in cold weather, lack of de-icing capability during periods of forecast icing, and lack of required visibility were responsible for the cancellation of four of five flights.)

The July 2004 Altair concept demonstration focused on operations within the National Airspace using a Beyond-Line-of-Sight (BLOS) communications to control the aircraft and receive sensor data. Scheduled missions included flights along the Maritime Boundary Line and within the High Seas Drift Net region. The Altair aircraft was equipped with wide-band and BLOS satellite communications equipment, a maritime radar, and vessel Automatic Identification System (AIS) interrogator.

The Coast Guard was able to remotely pilot the Altair vehicle from a ground control station in San Diego, CA during its transit along the West Coast to Alaska, demonstrating BLOS capability. However, satellite coverage in the northern latitudes is limited and, therefore, results in a very low "look angle" with the platform, preventing reliable BLOS command and control. As a result, the aircraft had to be flown at higher altitudes and above the cloud cover, which severely limited sensor capabilities during major portions of the test period. The Altair used AIS to provide intelligence about commercial vessels approximately 280 miles from the aircraft and was successfully used as a communications link to Coast Guard cutters within line of sight of the vehicle. Airframe sensor integration issues prevented a successful operational test of the maritime radar and wide area surveillance capability.

Similar to the first test, weather proved to be the biggest challenge. Ten of seventeen flights were cancelled due to forecasted icing, low cloud ceilings and poor visibility on scene and at the airport. The Altair never made it to either the Maritime Boundary Line or the High Seas Drift Net area. In fact, the Altair was not able to make a 360-degree turn anywhere within the Alaskan region due to the possibility of losing communications with the satellite.

Challenges Facing the Operational Employment of UAS in the Maritime Domain

The FAA and International Civil Aeronautical Organization (ICAO) are charged with maintaining safe and efficient aeronautical airspace. There are three areas the Coast Guard has concern relating to UAS flight safety: crew qualification, system airworthiness, and flight rules—especially collision avoidance. To gain access to national and international airspace we must and will work with FAA and ICAO to ensure the above areas of concern are adequately addressed so there is no detriment to civil aviation or public safety. The Coast Guard will utilize the FAA's Certificate of Waiver and Authorization (COA) process for domestic flight and "with due regard for civil aviation" over international waters. This process allows for limited scheduling of Coast Guard UAS operations in domestic airspace. We will continue to work closely with the FAA to overcome these challenges.

Coast Guard Outreach Regarding the Design and Operation of UAS

The Coast Guard continues to work with CBP, FAA and DOD on airspace access issues. We participated in CBP's source selection of the Secure Border Initiative UAS and are actively working with the Joint UAS Center of Excellence, the U.S. Marine Corps and Navy UAS working groups, DOD's Joint "Sense and Avoid" and airspace integration working group, and two FAA policy recommendation organizations.

Conclusion

In conclusion, I re-emphasize three main points:

- The Coast Guard remains eager to work closely with our interagency partners to operationally test and evaluate UAS technologies in the maritime environment. While UASs are not suitable for all mission types and may not replace manned aircraft in many of our current missions, they do provide potentially effective and economical capabilities that could become force multipliers for our maritime domain surveillance and detection missions. The Coast Guard has very little experience operating UAS but remains interested in realizing their potential as a long endurance wide area surveillance aircraft in the maritime environment.
- The Coast Guard envisions using a maritime sensor equipped, land based UAS to help mitigate the Maritime Patrol Aircraft (MPA) gap. The Coast Guard will continue to actively look for opportunities to use UASs to help close the existing MPA gap.

- Land based UAS operations have many distinct challenges. Several of those challenges were experienced in the Alaska maritime environment including degraded UAS satellite communications and sensor effectiveness due to weather conditions, lack of alternate landing sites and the limited number of remote/alternate runways that can accommodate UASs. The Coast Guard looks forward to additional opportunities to conduct further tests and evaluations of UAS technologies to accomplish wide area surveillance in the maritime environment.

Thank you for the opportunity to appear before the Committee today. I am happy to address any questions you may have.

The CHAIRMAN. Thank you very much. We will have to go vote and be back as quickly as we can.

[Recess]

The CHAIRMAN. I am sure the Co-Chairman is on his way, but I also am sure he wouldn't mind if I start and ask some questions. First, let me ask all of you a question. Without any question, we are dealing with a system that will not only be unmanned in terms of crew, but there also would be no people on board right? We understand that this is not dealing with any concept of a new system that would be unmanned as far as the crew situation is concerned, but wouldn't carry any passengers at any time? With that, Mr. Sabatini, your regulations would ensure that, right?

Mr. SABATINI. Yes, sir, absolutely.

The CHAIRMAN. Mr. Admiral Lautenbacher, we discussed the experiment in Alaska and you mentioned in your statement, one of the problems developed was the lack of deicing equipment on these birds. Has anyone looked into the problem yet in terms that the deicing equipment might be necessary to operate these things in all weather conditions?

Admiral LAUTENBACHER. I'm not aware that anyone looked specifically into it in the tests we've done, but I am confident that could be added into it. We've looked at operating out of Alaska bases, and we think that the issues that have come up can be dealt with basically. So I don't see any reason why you can't deal with a problem like that as you do with a manned aircraft in a way that could allow us to operate, and certainly if we operated out of Eielson—for instance, we could complete 90 percent of our mission that we need just today with the equipment.

The CHAIRMAN. Did your conference, Mr. Madden, look into that problem?

Mr. MADDEN. We raised the issue of under what conditions, what different types of UAS platforms could work, but said we have to go beyond raising the issue and actually test things, so there are large seasons of the year in which icing is not a problem, but the participants at our Alaskan workshop did go into it knowing that there could be issues with icing and that would be one of the early things we would have to test.

The CHAIRMAN. Well, let me ask you Mr. Sabatini, I had a conference this last recess following the 4th of July in Alaska with people who are concerned with the aviation safety. We have been very much involved with aviation safety, and I think we have accomplished a great deal in a very short period of time, but they mention there is no consideration being given to warning systems to prevent these unmanned aircraft from coming into the airspace of civil aviation that is flying on an approved flight plan, general or commercial. Have you all looked into that now? Are we going to some kind of warning device on this so the collision avoidance systems of small aircraft, or the commercial aircraft would work?

Mr. SABATINI. Well, Mr. Chairman that is a very complex subject. I would tell you that there is not today a warning system we've required of what those aircraft that have been approved to operate either under experimental certificate or either under a public use certificate of authorization because of what was asked to be done, however, there certainly is technology such as TCAS that can be put on board those aircrafts that would alert other manned aircraft that there is another intruder so to speak in that airspace.

The CHAIRMAN. Well, I've flown TCAS. I'm not sure it will pick up something that small will it? Do you know?

Mr. SABATINI. Well, I would say that as I mentioned in my testimony, Mr. Chairman, the limitation is on a piece of equipment like what we have here, the Raven, probably the weight of the TCAS itself is greater than the weight of this aircraft, and therefore, some aircraft such as these could not possibly carry the kind of TCAS equipment if we consider that warning to others that would make it feasible. This just simply could not be done.

Mr. MADDEN. We addressed that both in the workshop and in some conversations afterwards. We would see a number of applications where there would be listing temporary flight restrictions for civil authorities such as around fires or volcanoes, so that operating inside of those temporary flight restrictions would minimize or eliminate that conflict.

The CHAIRMAN. What do you think Admiral Justice?

Admiral JUSTICE. Sir, I would add two points. We know that there is one industry, one builder, who is looking and on the larger predator-type aircraft, they are looking into deicing. So that is under development. We know that for a fact. And then as well, on a smaller, in the Coast Guard, what we are looking to purchase for our ships is larger than that. It is more a medium-sized and again, from a collision avoidance perspective, we will be—that will be developed. That is part of our—we are kind of pacing ourselves for delivery of those vehicles because that technology is being developed. But it will all come together and it will have that to meet Mr. Sabatini's requirements here.

The CHAIRMAN. Just this last weekend, I saw two eagles that were bigger than that plane. TCAS would not be able to tell it was there if it was that small would it? I am saying, don't you think you should require putting something on this one that will emit a signal and it would be picked up?

Mr. SABATINI. That has been a challenge, Mr. Chairman. The technology that would be available to allow something like this Raven to be sensed by other aircraft, and that technology is not available for a small device like this one. It could potentially be available for a larger aircraft that can carry that kind of weight and cause itself to be sensed by other manned aircraft so that in that sense, that's a warning to others that there is another aircraft in their presence, and therefore, a TCAS type of arrangement could cause a warning to other manned aircraft. However, in unmanned aircraft, that technology does not exist today to allow the detection, the sensing and avoiding and the maneuvering that needs to be done to avoid other aircraft. And for that reason, we work with either the Government agency or the applicant as a civilian to establish the parameters within which they will operate, the restrictions that will be imposed upon those operations.

The CHAIRMAN. Admiral Lautenbacher, I think the staff told me about the use of one of these in terms of global climate change monitoring. It would drop sensors along the ice, or along either onshore or offshore, and pick up some measurements later. Now, what size—if that's true, what size UAV would be used for that?

Admiral LAUTENBACHER. This would be a much larger UAV.

The CHAIRMAN. Predator size?

Admiral LAUTENBACHER. It could be Predator size, it could be a little smaller, but generally a Predator that could go on a long mission and carry dropwindsondes, or even carry smaller UAVs with it and launch them at a particular point. So there is a variety of things that could be done.

The CHAIRMAN. Well let me ask you this. Have any of your agencies studied to determine what changes in existing law would be required to legalize the use of these concepts and put the restrictions on them, or give them the authority to put the restrictions on them that would be necessary in the interest of safety?

It would probably be you to start with, Mr. Sabatini.

Mr. SABATINI. Yes, Mr. Chairman, we have regulations today that address operation in the NAS. Unmanned aircraft cannot meet those regulations today. The challenge that we face and we are working through the RTCA which is a Federal Advisory Committee that has brought in industry to participate in Special Committee 203 to address the issue of detect, sense, avoid, command and control. So they are in the process of establishing what those standards might be so that industry can then begin to build avionics that are capable of providing what unmanned aircraft cannot do today. And that is operating within the NAS and be able to comply with FAR Part 91, the general operating rules in the airspace.

The CHAIRMAN. One of the groups I was with was float plane pilots. They point out that very few of those planes have any TCAS equipment on them. They are flying normally around 1,000 feet or below, and they believe that if we are going to authorize the use of these in Alaska, that we ought to have some zones like we have for military zones where—or at least there ought to be some advance notice to pilots before, considerably before they are used. Now, have any of you looked into those problems of the interference with the general aviation, particularly the aviation that is related to just local use? I mean, can we develop something for instance, let's say you can't fly these things within 20 miles of a municipality or something like that?

Mr. SABATINI. Well, we already have, so let me start by saying those devices cannot access the airspace today unless they receive approval.

The CHAIRMAN. But they are. You pre-approved them right?

Mr. SABATINI. They have to be approved by the FAA and when they are finally approved by the FAA, they are allowed to do so under very controlled circumstances. There will be restrictions.

For example, the one that operates along the Arizona/New Mexico Border. When they are authorized to operate, there are hours that are published that they do operate when they are going to access that airspace which I believe starts at about 12,000 feet to about 15,000 feet. From their base of operation, to gaining access and entry into that airspace is a specific period of time. It is announced by way of NOTAMs to airmen that this aircraft will be operating during these times and will be proceeding along this track to access that airspace, and once it's in that airspace, it's published to the community, the aviation community, they are not permitted in that airspace while it is "hot" so-to-speak.

The CHAIRMAN. That is sort of self-defeating. That tells people who are trying to watch those, going to be there——

Mr. SABATINI. We are not the ones to determine that, sir, we are the ones that allow safe operations by putting in the kinds of restrictions to permit those operations.

The CHAIRMAN. Well, I'm told that you are looking into FAA; FAA is looking into it for use disaster areas such as Katrina and other such disasters. Is that right?

Do you have any special regulations yet for that?

Mr. SABATINI. Well the regulations continue to be the same; however, we have already issued a Certificate of Authorization to DOD in anticipation of any potential new Katrina-type hurricane that would position them to be ready to operate within the confines of what has been approved for them to do.

The CHAIRMAN. I am interested in the concept of adding these systems to existing systems such as weather monitoring, volcano monitoring, fire fighting monitoring.

Is that feasible, Mr. Madden?

Mr. MADDEN. Yes, sir, it is and I think that while these are aircraft, there are ways in which we could minimize or eliminate the conflict with general aviation. I mean, I earned my private pilot license in Alaska and every hour I've flown as pilot in command is in Alaska. There could be something like not just having a corridor for these, but to have a cylinder or a cone for them to get at altitudes that operate above general aviation. That would put a great challenge for the technology for sensing to be done at say at flight levels at 18,000 feet or so, and where it's positive control. It would have more applicability to the larger unmanned aerial systems than the small ones like this. But it's fairly well documented where general aviation flies, for what purposes, for what times of year and what altitude.

And having flown in Alaska, I know there are 50,000 bald eagles in that state and I am more concerned with hitting an eagle than hitting another airplane.

The CHAIRMAN. They are there all right. Mr. Sabatini, how do you propose to coordinate these with the air controllers at airports that have general applicability?

Mr. SABATINI. Well the—whether it's an Experimental Airworthiness Certificate that is issued, or whether it's a certificate of authorization, it's done with complete coordination with the air traffic organization, so the limitations and the restrictions spell out in great detail the operation and who they need to contact almost to the point that this is the frequency in which you will contact, the approach control, the departure control, etc. It's highly coordinated, Mr. Chairman.

The CHAIRMAN. For the two admirals, as you know, we have been very interested in the system for the protection of our fisheries, particularly along the maritime boundary and to protect marine sanctuaries such as you described, Admiral, off of Hawaii, but clearly, we had a test as I mentioned, but are you still pursuing that idea to have vessels using UAVs? If so, can you tell us what you are doing?

Admiral LAUTENBACHER. Yes, sir, we have tried and experimented and run tests with Predator-size vehicles and we've also run tests with a smaller vehicle in the humpback sanctuary for looking at marine mammals and endangered species and that sort of thing, and we think it's a very promising method for the longer times that you can be watching and do it remotely. It has a great deal of appeal to us in terms of practical way of monitoring fisheries and marine mammals.

The CHAIRMAN. I was recently briefed on the military use of UAVs in the war zone and I was very surprised the manpower that is necessary to monitor the UAVs. It is actually more to take to monitor a manned aircraft. Are you aware of that?

Admiral LAUTENBACHER. Yes, sir. I've been out on these tests or been involved in the tests, and I would have to say, remember we're currently at the front end of the technology in learning how to use and control, but yes, you have to have pilots that fly the airplanes and consoles and communications equipment and communication video links and it's not without its technical complexity.

But I think as all other areas, it's going to get better as we try it more.

The CHAIRMAN. Well, it's cost-effective compared to you sending a cutter out there isn't it?

Admiral LAUTENBACHER. I'll let the Coast Guard answer that.

Admiral JUSTICE. Sir, I would say its part of the system. It's needed. It helps monitor, it helps detect. It may help sort at some point. We're not quite there with the sorting piece yet. At the end of the day, you know, the apprehension and the interdiction piece are going to be by a cutter. But it will help us use that cutter smarter. So again, the Coast Guard is committed to its technology improvements with them. We will work with the team here to use those.

The CHAIRMAN. And what is the timeline for that?

Admiral JUSTICE. Realistically, we're mirroring, you mentioned the three to four year development of the collision avoidance system on the, we call it RVUAV, so we have got a three to four year window for our—the ones off our cutters that will replace a helicopter. It's a three to four year window to roll those out. Right now, Coast Guard's plan with the big ones is out there. We don't—we're not signed up to use them until 2016. With that said, as we see the technology improving, we have been part of the test, we understand the problems, and we appreciate the problems. If the problems are overcome, and we'll help with that. We are definitely ready to move.

We would be ready to move forward earlier in using this technology full-time and on our missions.

The CHAIRMAN. All right, are you far enough along to approach the UAV manufacturers about equipment you need such as deicing equipment and monitoring equipment?

Admiral JUSTICE. And we have and they are working with us on that, yes sir. We're there with that.

The CHAIRMAN. All right, I believe Senator Inouye has been held up on the floor, so I'm going to suggest that we keep the record open, and he and the staff may submit to you some questions on the subject today.

My last question for you, Mr. Madden, you mention this airport that you envision having a UAV servicing station. How far along are you in developing that idea?

Mr. MADDEN. It's a concept to try to have a place where it could integrate flight operations, data acquisition and data analysis. It has not gone beyond the concept stage. I have talked with the State Department of Transportation about what airports could provide this, what space is available and meet the power and communications. They are ready and willing and able to meet with any agency about site selection. There is also a number of private sector owned and operated along the pipeline that have said they would agree to be either alternate airports, or forward deployed airports as well.

Mr. STEVENS. Well, I appreciate it. If you would let us know if you have any suggestions as to changes in existing law to facilitate the subject we've discussed, and I appreciate also if you would respond to the questions that may be submitted to other members of the Committee, particularly the Co-Chairman.

I do thank you for your participation and apologize for the Senate schedule holding you here this long is unconscionable but unavoidable, so thank you very much.

Mr. MADDEN. Thank you, sir.

[Whereupon, at 4:31 p.m., the hearing was adjourned.]

A P P E N D I X

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. DANIEL K. INOUYE TO VADM CONRAD C. LAUTENBACHER

Question 1. Admiral Lautenbacher, what can an unmanned aerial system (UAS) base in Hawaii do for the Western Pacific region and how can a Hawaii base complement an Alaska UAS base?

Answer. UAS could be used to collect routine measurements and observations from the Pacific region in areas where other observing systems, such as satellites, manned planes and buoys are either impractical or inadequate. Data collected from UAS could be used for a broad range of applications, including climate and weather prediction, monitoring of Pacific cyclones, volcanic monitoring, identification of marine debris, coral reef mapping, monitoring of coral reef bleaching, marine mammal surveys, fisheries enforcement, and monitoring the recently dedicated Northwest Hawaiian Islands Marine National Monument.

Question 2. What uses of UAS are better suited for Hawaii than Alaska?

Answer. Hawaii would be better suited to study the tropical aspects of the global weather and climate system, versus Arctic studies from a site in Alaska. Data from both regions are needed to better understand the current changes in global weather and climate, and to improve weather and climate prediction. For example, data from UAS based in Hawaii could be collected to improve understanding of Pacific cyclones and storms, their formation, evolution and intensity. As described in greater detail in testimony, NOAA's Hurricane Research Division (HRD) demonstrated the proof of concept for potential UAS applications in severe storm environments during September 2005. NOAA used a relatively small UAS to obtain and transmit real-time, potentially useful, low altitude storm data. While the successful use of manned aircraft has been an important tool for understanding hurricanes, detailed observations of the near-surface hurricane environment have been elusive because of the safety and technical risks associated with these low-level manned missions. A follow-on hurricane UAS demonstration over the Western Atlantic Ocean and Gulf of Mexico will take place during September 2006.

Question 3. Would UAS be helpful in monitoring and preserving the Northwestern Hawaiian Islands? Is this a good technology to keep help this area pristine?

Answer. The Northwest Hawaiian Islands Marine National Monument, designated by President Bush on June 15, 2006, encompasses nearly 140,000 square miles—an area larger than all of our national parks put together. As described in our testimony, this monument is one of the least accessible of our national treasures and presents ongoing challenges to ensure its monitoring, conservation, and protection. UAS based in Hawaii could take measurements of the monument and other Pacific Island regions that are too remote for most sustained manned aircraft observations. NOAA's National Marine Fisheries Service (NMFS) currently collects data around these islands using a combination of platforms including research vessels, aircraft, satellites and individual researchers on the ground. Observations from these platforms could be augmented by observations from a UAS once they are calibrated into the observing system. UAS have the potential to address a number of additional issues in the Pacific including detection of marine debris, monitoring coral reef bleaching, and supplementing our national climate and weather prediction models.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. DANIEL K. INOUYE TO REAR ADMIRAL WAYNE JUSTICE

Question 1. Rear Admiral Justice, the Coast Guard's District 14, which includes Hawaii and the Pacific Territories, appears to be having difficulty in fulfilling its fishing enforcement mission. Over the past five years few, if any, of the suspected illegal incursions of foreign fishing vessels within the Western/Central Pacific area of the U.S. Exclusive Economic Zone (EEZ) were detected by the Coast Guard and none were interdicted by the Coast Guard.

The Coast Guard has determined that Unmanned Aerial Systems (UASs) are "ideally suited" for providing fishing enforcement capabilities and the agency is currently acquiring UASs through the Deepwater program to be used for a number of surveillance missions in the region, including efforts to deter and prevent foreign vessel incursions into the EEZ.

Can you tell us how UASs can be used for fishing enforcement and how they will help the Coast Guard to improve overall surveillance capabilities?

Answer. The Integrated Deepwater System depends on unmanned aerial vehicles to provide airborne organic intelligence, surveillance and reconnaissance capability to detect, classify and identify targets of interests (including fishing vessels) out to 100 nautical miles from the cutter. The use of drone aircraft offers the potential to provide a significant amount of air patrol hours for the Coast Guard. With the capability to fly for more than 30 hours without refueling, the land based UAVs have a significant on-scene persistence advantage over manned aircraft, resulting in a significant improvement of Coast Guard maritime domain awareness (MDA).

Question 2. How would Unmanned Aerial Vehicles (UAVs) coordinate with ground assets to detect and make contact with foreign fishing or other vessels that illegally enter the EEZ?

Answer. The Deepwater unmanned aerial vehicles will use a surface search radar and Electro Optical/ Infra-Red sensors to detect, classify, and identify surface contacts (targets of interest). The Coast Guard UAV mission commander/pilot will also have the capability to communicate directly with targets of interest and additional government resources.

Question 3. What are the strengths and limitations of UASs in the surveillance of fishing vessels in the high seas?

Answer. A High Altitude Endurance Unmanned Aerial Vehicle (HAEUAV) is a long endurance wide area surveillance system with a capability to fly for more than 30 hours without refueling. These land-based UASs have a significant on-scene persistence advantage over manned aircraft, resulting in a significant improvement in Coast Guard maritime domain awareness capability.

7Until the Federal Aviation Administration (FAA) adopts new regulations governing the operation of UASs, the Coast Guard will comply with the FAA Certificate of Waiver or Authorization (COA) process to gain access to the National Airspace System (NAS). The COA process for a single mission takes 60 days to complete. COAs are very restrictive and support a specific mission for a specific period of time. UAS operations within the NAS and International Civil Aeronautical Organization (ICAO) regulated air navigation systems are currently limited in their employment capability due to the extensive and time consuming COA process.

There are three areas the Coast Guard has concerns relating to UAS flight safety: crew qualification, system airworthiness, and flight rules—especially collision avoidance. The Coast Guard realized during the 2003 and 2004 concept demonstrations in Alaska that UASs have limited utility in poor weather conditions, as the sensors are unable to identify vessels in low visibility. The Coast Guard also learned that Beyond Line of Sight (BLOS) satellite communications are limited, and in some cases non-existent, in the northern latitudes.

As UAS technology advances, solutions will be developed to address both weather and technological challenges, such as sense avoidance and satellite communications reliability. Small UASs, as well as the HAEUAVs, will extend the operational commander's eyes and in effect extend his operational presence on the high seas.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. DANIEL K. INOUYE TO NICK SABATINI

Question 1. Mr. Sabatini, years of military and government applications suggest significant opportunities for the use of Unmanned Aerial Systems (UASs) in the commercial sector, but there are obvious reasons for caution, particularly related to the safety and security of the National Airspace System (NAS). You have indicated that the Federal Aviation Administration (FAA) has only currently issued two experimental certificates to private industry.

Answer. The FAA has issued 3 Experimental Airworthiness Certificates in the last year. While the initial interest with industry seemed to be high at the outset of Unmanned Aircraft System (UAS) activity, it has dropped off considerably. At this time, the FAA is in receipt of only 2 additional program letters, which should lead to the further issuance of additional Experimental Airworthiness Certificates after formal review.

The government use of UASs has generated significant interest by industry to pursue the potential for this new technology. However, the current state of development of the technology is in the initial stages and requires much more maturity before it can be seamlessly integrated into the National Airspace System (NAS). Government partnering with industry can collaboratively develop the path to facilitate this integration with no negative impact to system safety.

Question 2. Does the FAA have an estimated timeline for when it will move beyond the experimental stage of private UASs operations?

Answer. The FAA is developing a roadmap for the integration of UASs into the National Airspace System (NAS). This roadmap will define all of the activities, policy development, standards development, modeling and simulation, and resources necessary to have in place before UASs can move beyond the experimental process. The FAA projects it will take approximately 5 years to complete the roadmap objectives. The roadmap is expected to be finalized by March of 2007.

Question 3. Given the on-going effort to modernize the NAS and permit a tripling of capacity by 2025, is the FAA contemplating the potential impact of UAS flights on the system?

Answer. The FAA is working closely with the Joint Planning and Development Office (JPDO) to ensure that all known potential impacts to future NAS architecture and current infrastructure related to UAS are identified. As JPDO is a government and industry forum, industry has an opportunity to discuss commercial applications that may impact the NAS of the future. Given the relative newness of this technology and a corresponding lack of experience with it in the aviation industry, it is very difficult to predict the potential impact with any degree of certainty. Much will depend on specific activities, standards and policies, yet to be developed, that will ensure UASs have an equivalent level of safety to aircraft already operating in the NAS. Until such time as these policies and standards are in place, we have a system and processes that can and are accommodating limited access to the NAS in a manner that preserves the current level of safety. It's also important to note that, as with very light jets, any increase in the numbers of UASs in the NAS will be gradual.

Question 4. Do you have any forecasts as to the expected growth of UASs over this period?

Answer. FAA has not developed any forecasts due to the relative newness of this technology. Until the standards are developed and the technology is matured, it is difficult to develop such a prediction. FAA is aware of several externally developed projections that have forecasted spending levels by industry on the range of $5–8 billion over the next 10 years. This may correlate with the development for the activities being pursued by manufacturers in support of the U.S. Government, but it does not correlate with the minimal amount of interest that industry is showing in the area of civil applications, which would result in the pursuit of an Experimental Airworthiness Certificate.

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