NATIONAL WEATHER SERVICE (NWS) MODERNIZATION PROGRAM STATUS

HEARING

BEFORE THE

SUBCOMMITTEE ON ENERGY AND ENVIRONMENT

OF THE

COMMITTEE ON SCIENCE

U.S. HOUSE OF REPRESENTATIVES

ONE HUNDRED FOURTH CONGRESS

SECOND SESSION

FEBRUARY 29, 1996

[No. 57]

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NATIONAL WEATHER SERVICE (NWS) MODERNIZATION PROGRAM STATUS

THURSDAY, FEBRUARY 29, 1996

U.S. HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE,
SUBCOMMITTEE ON ENERGY AND ENVIRONMENT,
Washington, DC.

The subcommittee met at 10:25 a.m. in Room 2318 of the Rayburn House Office Building, the Honorable Dana Rohrabacher, Chairman of the Subcommittee, presiding.

Mr. ROHRABACHER. The hearing of the Energy and Environment Subcommittee will come to order. This oversight hearing will examine the progress of the National Weather Service modernization program, to answer the question, is it on time and on budget?

We will focus on the major acquisition program known as AWIPS. The Science Committee and this Congress have been fully supportive of the modernization program, and there is no question that the public will benefit from the use of state of the art radar systems and the GOES and POES satellite program.

That's why we worked hard last year to fund these programs, while meeting our budget caps.

However, in a shrinking budget environment, we cannot afford mistakes in a $4 billion program that lead to major cost overruns. This program has a troubled history. The cost has gone up, and Congress has paid the bill anyway. Next time, however, money won't be there, unless we're satisfied that it's being spent in exactly the best way possible.

We have to be sure the taxpayers are not paying for our gold-plated system, when a no-frills system will do. It's up to us to see that sound business practices are being used to certify equipment and set timetables. We must also be sure the promised results, which we're talking about better forecasts, for at least the same amount of money, if not less money, will be realized.

Both the GAO and the Inspector General of the Department of Commerce raised serious questions in both of these areas. We will hear from the GAO that AWIPS is at risk from the lack of quality assurance, and from the Department of Commerce IG, we will hear that its timetable is unrealistic.

We will also hear a vigorous defense from NOAA's administrator, and a positive report from a member of the National Research Council's Modernization Committee.

So I look forward to a spirited dialogue. And as is the basically modus operandi that I'm trying to use in this subcommittee, we want people, the expert witnesses, to confront each other's argu-

ments. And we want the members of the committee to be participants in the dialogue and try to get to the heart of the matter.

So before I introduce our panel, I will ask our distinguished ranking minority member, and if there are other members—I understand this is an issue of serious concern to many of our members. If there other members who have opening statements, we will permit those as well. But we will turn to our ranking minority member, Mr. Roemer, for his opening remarks.

Mr. ROEMER. Thank you, Mr. Chairman.

With that, I would like to ask unanimous consent to have a statement by Congresswoman Sheila Jackson Lee entered into the record.

Mr. ROHRABACHER. Without objection.

Mr. ROEMER. Thank you, Mr. Chairman.

Before I get into some prepared remarks, let me just thank Dr. Baker and Dr. Friday for the tour of this program. Preceding the opening statements, we will hear from this distinguished panel.

I can't help but be reminded, as they gave the tour, of how the state of the art computer operation will work, and how we see the individuals sitting over there in the picture at the desk with seven or eight different screens in front of him, running around from one screen to another, trying to memorize what was on a screen, and then put that data back into another screen.

I can't help but think how we all have this kind of experience in our own homes, as we're trying to consolidate our stereo and our album, disk player and our cassette player and our TVs. And the wires are hanging out everywhere. And it's very difficult for us to get a grasp on this new technology. Some people's VCRs are still blinking.

I think this is technology that we must understand, that we have to make sure that can be used in an efficient manner, that has to stay within budget, but that can provide some very, very important services for our commercial community.

And as I work with Dr. Friday and Dr. Baker on this committee, to try to privatize certain aspects of the weather service, and not see the duplication on the part of the government doing the private sector's job, where the private sector can do it better, and also glean jobs and income from it, this certainly might be something as a work station that can be transferred to the private sector, as Dr. Baker said, for somewhere between maybe $75,000 and $100,000, as a work station.

With that, let me get into some prepared remarks.

Mr. Chairman, first of all, I want to acknowledge the importance of this hearing, and thank you for looking at the weather service modernization program. No other program within our jurisdiction will touch as many Americans as personally as the National Weather Service, and the modernized forecasting system we are attempting to put into place.

In addition, no other program within our jurisdiction will so clearly achieve economic benefits many times in excess of the cost.

Once the modernization is completed, segments of the U.S. economy will see benefits of more than 7 billion per year. This is in every sense of the word an investment. The compelling justification

has led to a widespread bipartisan agreement in Congress to support NOAA through this transition process.

This agreement has now transcended three different administrations. This is, however, a two-way street. And I am certain that NOAA recognizes its obligation to keep the Congress informed, and to focus its very best management and effectiveness on this program.

Today we will be discussing some of the problems that have been encountered in the AWIPS program, and some of the decisions that will need to have been made to keep this program on track. We will hear about some contract and programmatic problems that are real and troublesome within the budget.

But AWIPS, as we will hear, is and will be the nerve center of the future weather forecast office. It will give the local weather service the information and the communication capabilities that will be needed to fulfill the basic mission of the national weather service, to provide warnings and forecasts for the protection of life, and the protection of property.

Obviously, we feel the responsibility as an oversight committee to see that this is done right, and done on time.

I hope today's hearing will give the committee a better understanding of exactly what needs to be accomplished to make the decision to enter into full production and deployment of AWIPS system later this year. What are the reasonable criteria that we can use to judge whether you have made enough progress to make a prudent decision?

Finally, I hope that we as a subcommittee can resist the temptation to micro-manage this program. Clearly, it has had its share of troubles, and it has had its share of reviews. But by many accounts, it has also had its share of progress.

I believe we can all agree on the ultimate objective of fielding a working system as soon as we can, given the spinoffs that I mentioned before in economic benefits, and that this is an investment for commercial technology.

Once again, Mr. Chairman, I want to commend you for holding this hearing, fulfilling our very important objective as an oversight committee. And I look forward to the expert testimony that we'll have this morning.

Mr. ROHRABACHER. Thank you very much, Mr. Roemer.

I'd like to acknowledge the presence of our distinguished former chairman, Chairman Brown, who during his tenure of Chairman of the Science Committee, actually participated in starting many of these reform and modernization programs, and would like to thank him for participating in our subcommittee today because he provides us a degree of institutional memory that will make sure that we finish the job we started, and do it right.

Mr. Brown, is there any opening statement that you have?

[No response.]

Mr. ROHRABACHER. Thank you very much.

We have short opening statements from Mr. Davis and Mr. Ehlers.

Mr. Davis, would you like to proceed?

Mr. DAVIS. Thank you, Mr. Chairman.

I commend you for holding this hearing. The National Weather Service Modernization program is of vital importance. As you know, weather service modernization touches every American in every part of our country. This program will really advance our ability to forecast floods, hurricanes and tornadoes, and other weather patterns.

I believe we need the system completed as quickly as is responsibly possible. That's the question before us today—how quickly can we complete the system and ensure effective operation?

To offer their perspectives, we have witnesses today, the Commerce Department Inspector General, the GAO, Jet Propulsion Lab, which serves a key role in the independent review of the various components of the modernization effort, and the National Weather Service.

At a time when many of us in Congress are justifiably seeking reduction or elimination of wasteful or inappropriate government functions, the National Weather Service passes every test. It's a service critical to each and every American citizen. The NWS gives us the reliable weather forecasting that we need and rely upon.

I welcome the views of the GAO and the Inspector General, and I've read their reports on the weather service modernization. Oversight is critically important. But when it comes from too many directions, it serves no purpose except to delay and turn the development of a major system into little more than confused paper debates. This type of action can end up costing taxpayers tens of millions of dollars.

With the weather service modernization, delay means the potential loss of hundreds of millions of dollars that might otherwise be saved if floods, hurricanes, and the like could have been forecast sooner.

More important than the economic loss is the loss of lives that might have been avoided.

Mr. Chairman, the Defense Authorization Act recently signed by the President includes major procurement reform provisions. I worked on and sponsored those changes with Government Reform Oversight Committee Chairman Bill Clinger.

One of our objectives in that bill was to encourage more communication and cooperation between users and sellers. We specifically encouraged a systems development approach, now being used by the National Weather Service, to incrementally develop and deploy AWIPS.

Prior to this incremental developmental approach, an elaborate and costly contract bureaucracy was put in between the end user and the provider. Congress has endorsed this new approach, which I support, with passage of the procurement reform provisions of the Defense Authorization Act.

AWIPS's launch was a good example of why the old approach to systems development doesn't work. The contract began with an agreement between one company and the National Weather Service, between those two, and against the wishes of the National Weather Service was added a contract shop called the Systems Program Office, which inhibited communication between the two parties, who should have been constantly talking.

The same direction then came from different offices, the IG, the GAO, the GSA, and an independent review team. As such, the program was delayed, and the price went up.

Today, we seem to be back to the end user and the company who are now working together, and are moving forward. This is the way the system should work.

Mr. Chairman, let me close by wishing all involved much success. Our country needs the benefits of their services.

Thank you.

Mr. ROHRABACHER. Thank you, Mr. Davis.

Mr. Ehlers?

Mr. EHLERS. Thank you, Mr. Chairman.

In the interest of time, I will forego my opening statement. Thank you.

Mr. ROHRABACHER. Thank you very much, Mr. Ehlers.

Just one note before I introduce the panel. We are a very conservative lot here in Congress now, in the sense that we are trying to meet a goal, a self-imposed balanced budget restriction. We are taking that goal very seriously, yet we have fundamental things that government has to do for the people of the United States.

This is one of the fundamental services that we believe, whether you are conservative or liberal, you believe that this is something that needs to be done for the people of the United States. And it's a service that can be provided by the government.

So I'm very pleased that we are all here taking this job—and it's a bipartisan job—of oversight seriously. And we look forward today to our panelists.

Mr. Davis raised some questions, and I'm sure other members of the committee have some questions as well. So on our panel today are Dr. James Baker, Under Secretary of Commerce for Oceans and Atmosphere at NOAA, Administrator as well.

Welcome back, Dr. Baker.

Frank DeGeorge, Inspector General of the Department of Commerce.

Mr.—and I'll tell you, with a name like Rohrabacher, I never can complain about other people's names—it's Zygielbaum, from CalTech's Jet Propulsion Laboratory. And he serves on the National Research Council's Weather Modernization Committee.

And Mr. Jack Brock, Jr., of the General Accounting Office.

Gentlemen, your full testimony will without objection be entered into the record. And I hope that you will summarize, but I want you also to feel comfortable in going to your central points, and feeling free to expand on the central points any way that you choose, so we can move on to questions after the opening statements from each of our witnesses.

Dr. Baker.

STATEMENT OF DR. D. JAMES BAKER, ADMINISTRATOR, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION AND UNDER SECRETARY FOR OCEANS AND ATMOSPHERE, UNITED STATES DEPARTMENT OF COMMERCE

Dr. BAKER. I thank you, Chairman Rohrabacher. It's a pleasure to be here.

I am pleased to report that the modernization and associated restructuring of the National Weather Service is, as many members have pointed out, progressing rapidly.

By the end of January 1996, last month, we had installed 143 of the 161 of the planned NEXRAD radars, which are jointly put in place by the weather service, the FAA, and the Department of Defense. The last radar is scheduled for delivery in July of 1996, not including some additional radars that have been recommended by the recent report by the Secretary of Commerce, to Congress.

About 700 of the 930 planned tri-agency automated surface observing systems have been installed across the country. We have two new geostationary orbiting environmental satellites. And some of the pictures in those satellites are shown on the system over here. Those two satellites are now operational in providing regular data.

A new Class VII computer is running at the National Centers for Environmental Prediction, and we are already reaping the benefits of this improved forecast and warnings that this new technology provides us.

About a year ago, Mr. Chairman, you remember that California was ravaged by record floods and flash floods. It was the data from our NEXRAD radars that provided the forecaster with information about where the heavy rain was, and enabled them to issue flash flood warnings for those areas before the rivers and creeks rose above their banks. And there is, I think, very positive publicity from that, something we simply couldn't do with the old radars.

Just two months ago, there were tremendous windstorms in the Pacific Northwest, and it was the satellite observations and the forecast models that allowed the forecasters to issue storm warnings and high wind warnings with sufficient lead times, so that we could close public schools, and to shut down the city in anticipation of some extremely high winds, some in excess of 100 miles an hour, which is very unusual for the Pacific Northwest, as you know.

Well, the remaining piece of this complex technology is what we call the Advanced Weather Interactive Processing System, AWIPS. It's the cornerstone of our modernization, because it allows us to pull together all of the data by meteorologists and hydrologists, and it provides for dissemination of the products and information to users.

We have a system over here for the Committee to look at. There is a work station that's similar to what we call the pathfinder system, that is now installed and operating at three field offices. And we'd be happy at the conclusion of the hearing to give a demonstration of the work station, as well as what we call an advanced AWIPS-type work station that has been provided by NOAA's Forecast Systems Laboratory.

This is an example of our incremental build as we move forward here. This process of modernizing the weather service has been an intricate and evolutionary one, and it's been a real transition from an old system to a new system. It streamlines our organization. We're deploying new technology to immediately improve weather services.

Without the advanced Weather Interactive Processing System, without AWIPS, the field operations will never be able to achieve the level of efficiency and the quality of products and services that we can do with the technology that we have.

Now more than ever, we need to move ahead and finish the modernization so that we can provide a state of the art weather service that continues to be the world's most advanced, and that can provide improved weather services for all parts of the nation.

This is the way that we can reap the benefits of the technology that we have put in place, this $4 billion investment in the modernization of the weather service, and it allows us to streamline the weather service with a significant reduction in number of weather offices, and in number of people.

We have a plan in place, and it's important that we continue to do this. We have made significant progress over the past year with AWIPS. The development is progressing rapidly. We restructured that program to provide some system capabilities early that support improved and cost-effective weather services.

We are following an evolutionary process, and we see this being accomplished in several carefully-planned increments. It's critical that we bring these increments to the field forecasters, and to the public in the economic sector as soon as possible.

This is a phased approach, and it provides a more manageable transition by the field forecasters, and better mechanisms that ensure that the system delivered is effective.

Is there risk? Yes, there's risk.

There's always risk when you're putting together new technology and new computer systems. But we believe this is a risk that is manageable. And it is far more manageable than the approaches taken in the previous industry system development projects, which have been characterized by the term "big bang software" where you try to develop everything before you go out to the users. We know that doesn't work.

We're confident that this current incremental approach is wise, and it offers the least risk to the program.

Dr. Herb Kottler, from the MIT Lincoln Lab, headed an independent team to assess the AWIPS program, and evaluate the direction. They found that the development and incremental enhancement is rapidly becoming the architectural system of choice.

We began this incremental process with the rapid development and deployment of the AWIPS Pathfinder system. That's what we have over here. It involves the operation of a centralized network monitoring and control facility, our NOAAport data broadcasting service where you actually get the data that's currently available throughout the country, the initial site-to-site communication system, and contractor provided maintenance and logistics support.

What we've discovered is that the forecasters love it. They rapidly adapt to the new technology. They're now using the GOES data operationally in a level that simply is not available outside the AWIPS system where you cannot get the rapid updates.

They're able to sit at one work station and analyze radars, satellites, computers models, and surface observations in a way that simply won't work any other way.

We plan to install additional AWIPS and additional locations by mid-spring, with operational testing and evaluation taking place in early summer. That will give us sufficient information to proceed with a Secretarial decision for deployment in late summer.

Now, we're well aware of the interest from other groups that provide management advice to us—the Inspector General, the General Accounting Office, GSA, and so on—and we try to be fully responsive to this. The draft General Accounting Office report that was prepared for this Committee raises a number of concerns that the weather service has not fully justified all of the AWIPS capabilities.

I disagree with that conclusion. Our mission is to provide weather and flood forecasts and warnings for the protection of life and property. We are continually testing and evaluating the capabilities in operational forecast and warning operations.

To the extent that capabilities are not useful, but design approaches are incompatible with human computer interactions, we've discarded or reworked those. We have spent about 10 years working with our Forecast Systems Laboratory, examining and validating requirements for this kind of system.

We have had numerous separate, independent reviews of AWIPS's requirements conducted, and each has concluded that the AWIPS requirements are essential for forecast operations and services.

We have a risk reduction activity that's being conducted in Norman, Oklahoma, and Denver areas, with a lot of severe weather, to examine aspects of operations that are associated with staffing levels for initial AWIPS deployment, developing and field testing of AWIPS capabilities that eventually lead to final staffing targets that have been underway for several years.

Our staffing levels projected for the end of modernization have changed from the initial levels that were set in the original strategic plan. These changes are due to changes in the tri-agency NEXRAD program, in cost-comparison studies for maintenance and training.

In some cases, we found that it is simply cheaper to do in-house training, rather than go to outside contractors, than from Congressional directions to enhance the field office network.

While staffing adjustments represent a total increase from the original target staffing level, we are reducing overall weather service FTEs from a pre-modernization level of about 5,100 to the current post-modernization planning level of 4,678.

We've incorporated the planned FTE savings into our current streamlining plan, and our dollar savings into the budget profile.

Mr. Chairman, just a few concluding words. We continue to hear and read interesting commentary on the performance of our automated surface observing system. I mentioned earlier that over 700 systems are installed.

I'd like to point out that these systems are providing today over 1 million observations of weather per day. We are bringing surface observations to small airports, in particular, that have never had observations before. The airports are embracing this capability because it allows them to serve as jet ports to receive cargo flights, or as alternate routes for major carriers.

I have data today that we can provide for you from a weather service FAA aviation industry demonstration that shows just how well this automated surface observing system performs. Similarly, independent climate data continuity studies confirm the accurate, and in some cases much improved measurements that this surface observing system provides.

The surface observing system was built as part of a whole observing system that includes satellites and radars. The exhibit that we have—and it's shown on the picture over here—shows the rich observational environment, that we have some of the data from the observing system and from a camera.

Weather cam briefing means camera briefing, so we can compare what the camera sees and what the surface observing system sees.

To conclude, Mr. Chairman, the modernization is a complex process that will provide a uniform high quality of service across the country in a streamlined weather service organization, with a significant reduction in FTEs. With the implementation well underway, the modernization and associated restructuring has just passed its midpoint, and it's more crucial than ever to stay the course.

Drastically altering the plan at this point would jeopardize the delivery of new and improved services to the nation. We appreciate your continuing support to complete this national important undertaking.

I'd like to say, as a final point, that we are working with the National Research Council to have an independent assessment of operational test and evaluation. This is something the Committee has urged us to do. We are working with the Research Council to do that. They will look at the methodology and the conduct, and results of operational testing and evaluation.

They will review the plans to ensure that the criteria is met. They'll monitor the testing, and review the results and related actions. And we commit to working with you, and discussing with you, reporting back to you immediately when we hear those reports, so that you're fully aware of what they say, and what our response to that is, Mr. Chairman.

We know you're concerned about this. We are also concerned, and we want to make sure there's a transparent interchange of information from the independent review committees.

Thank you.

[The prepared statement of Dr. Baker follows:]

Insert T.2

TESTIMONY OF
DR. D. JAMES BAKER
UNDER SECRETARY FOR OCEANS AND ATMOSPHERE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

BEFORE THE

SUBCOMMITTEE ON ENERGY AND ENVIRONMENT
COMMITTEE ON SCIENCE
U.S. HOUSE OF REPRESENTATIVES

FEBRUARY 29, 1996

Thank you, Mr. Chairman and members of the Subcommittee, for this opportunity to testify on the modernization of the National Weather Service (NWS). My remarks will include a status of the modernization, and address what I believe to be many of your concerns relating to the modernization technologies and issues in the NWS.

The modernization and associated restructuring of the NWS is ushering in a new era for severe weather and flood warning and forecast services in the United States. Important advances in the science of meteorology, coupled with major new technological capabilities for observing and analyzing the atmosphere, are providing unprecedented improvements in weather services for this Nation. With implementation well underway, the modernization and associated restructuring of the NWS is just past its mid-point and it is more crucial than ever to stay the course.

Since I became the NOAA Administrator a little over three years ago, I have seen a remarkable improvement in the services provided by the NWS and renewed enthusiasm with which those services are provided. Increased accuracy and timeliness of weather warnings and forecasts have been evident in recent years, beginning with the forecasts for the "Storm of the Century" in March 1993, and continuing with the second most active tropical season ever, windstorms, record floods, blizzards, tornadoes, and snowstorms that have ravaged our Nation this year from coast to coast.

Actual performance of the new systems in an operational environment and initial responses from users of weather services have provided opportunities to examine successes and failures, and to assess the validity and viability of the modernization plan and the implementation approach. The recently completed National Research Council study and the Secretary's Report to Congress on Adequacy of NEXRAD Coverage and Degradation of Weather Services under National Weather Service Modernization for 32 Areas of Concern are but two recent examples of independent reviews which support our approach.

I can state confidently that much of the improved timeliness and accuracy of the forecasts and warnings that we as a Nation have experienced recently is due directly to the modernization of the NWS. Technologies deployed as part of the modernization

include new Doppler radars, the now operational new Geostationary Operational Environmental Satellites (GOES), the Class VII supercomputer, and the Automated Surface Observing Systems. Yes, we have had our difficulties with the new technologies, but the results continue to exceed our expectations. Data from the Weather Surveillance Radar 1988 Doppler (WSR-88D) continue to provide our forecasters with data describing atmospheric events that we did not know occurred or could heretofore only theorize. Detailed one kilometer images from the GOES, available as often as every minute, have given us only our first glimpses of how we can use that information in our warning program. Improved and far more detailed computer simulations of the atmosphere are being generated on the Class VII supercomputer providing our forecasters and the private sector with better forecasts than ever before. ASOS, and its continuous weather watch, allows us to observe atmospheric phenomena, such as the effects of gravity waves, at a level of detail that has never been available before using our old manual methods.

The modernization and associated restructuring of the NWS is a deliberately planned transition process designed to ensure public safety while introducing improved services as rapidly as possible. We have met significant milestones in the modernization. Two GOES satellites now cover our Nation and adjacent oceanic regions from west of Hawaii to the coast of Africa. This is the first time in almost a decade that people of

our Nation have not had to sacrifice some satellite coverage because we had only one operational geostationary view from space. At the end of January, we have installed and commissioned 143 of 161 NWS WSR-88Ds, with the last radar scheduled for delivery in July of this year. This does not include the additional radars recommended by the Secretary's report to Congress. We also have installed ASOS at almost 700 of the planned 930 FAA, NWS and DOD locations across the country, and commissioned 129 of the 306 NWS sites.

All these new technologies employed by the NWS modernization provide an amount of data that could become overwhelming if the system which processes these data and then disseminates the improved products is not modernized as well. The Advanced Weather Interactive Processing System (AWIPS) is designed to replace the outdated Automation of Field Operations and Services (AFOS) system, allowing meteorologists to access, integrate, and use all the information available to generate advanced meteorological and hydrological products heretofore unavailable. The cornerstone of the modernization is AWIPS: the integrator of the data for the meteorologist, and the disseminator of the products and information to the users and the general public.

Now more than ever, we need to move ahead and get the modernization finished in order to: 1) achieve a state-of-the-art

weather service that will continue to be the world's most advanced and that can provide improved weather services for all parts of this Nation; 2) reap the full monetary benefits to various sectors of the economy that the investment in modernization will make possible; and 3) produce a streamlined NWS organization with a significant reduction in operating offices and attendant staffing.

The modernization and associated restructuring of the NWS is an intricate, evolutionary, transition process to streamline the organization while deploying new technology to improve weather services that affect this Nation. The process must be viewed in its entirety.

NEXRAD

The NEXRAD program is nearing completion, with the last of the "original" 161 radars to be installed in July of this year. As you may recall, there were many who doubted the capability that this system offered. In fact, some called for the elimination of the NEXRAD program. I am extremely pleased that the results from operational use of the NEXRAD have far exceeded our expectations. Our warning for flash floods and severe weather, such as tornadoes, hail, and strong winds, has improved dramatically. In addition, our ability to not issue false alarms, or "cry wolf," has improved dramatically from the era prior to modernization. Better warnings equates directly to

lives saved.

The Secretary presented his report to Congress on Adequacy of NEXRAD Coverage and Degradation of Weather Services under National Weather Service Modernization for 32 Areas of Concern. This report recommended the addition of three NEXRADs to the national network. The total mid-course adjustment to the strategic plan to modernize the NWS represents only about 0.5 of one percent increase in the overall cost of the modernization, excluding satellites. We are working with the Administration to include in our FY 1997 budget request funding to implement the items recommended in the Secretary's report.

GOES

We now have two operational GOES, one tracking storms over the western United States and eastern Pacific Ocean, and the other keeping vigil over the eastern U.S. and the Atlantic Ocean. As I mentioned in my introduction, this is the first time in more than a decade that we have been able to meet this operational requirement. In spite of early concerns about the capabilities of these satellites, the digital data from the new GOES systems are vastly improved from the previous GOES analog data, providing far more detail in space and time than ever before. Even though NWS forecast offices will not be able to fully utilize and integrate the GOES digital data stream until the deployment of AWIPS, we recognize the importance of using this critical data as

quickly as possible. NOAA has taken aggressive actions to provide local forecast offices and national centers with this new digital data stream. In anticipation of the delivery of AWIPS, many field offices are utilizing, to the extent possible, advanced workstation technology designed primarily for training and technological assessments, to access the GOES digital data. These data are used for forecasting and monitoring events such as Great Lakes snow squalls, valley fog, and coastal storms.

ASOS

ASOS is proving to be a highly accurate, consistent and reliable complement to meteorological operations. ASOS was designed as one part of the NWS modernization that also includes other powerful observing systems such as NEXRAD and GOES. We are working to improve ASOS acceptability by the aviation community. ASOS is well received by many segments of aviation users. General aviation and helicopter users embrace ASOS, as do regional airlines to a large extent. Major airlines continue to be the most reluctant to accommodate change. Recent climate continuity study results to date indicate that ASOS is providing the most accurate temperature data ever.

Weather support and critical weather decisions concerning aviation safety is a highly complex process involving hundreds of decision makers supported by these sophisticated technologies. Aviation safety and operations benefit from the ability to

integrate data from all of these sources, rather than from the interpretation of ASOS data alone.

ASOS provides some information in a manner that is somewhat different from the standard "surface airway observation" (SAO), that has evolved over many decades into a "catch all" for information. The SAO was developed in the teletype era when it was the only form of information available for pilots to know about current weather conditions.

Since the inception of the SAO, much we observe about the weather has changed. Radars have become commonplace, including the NEXRADs. Satellites now continually monitor rapidly evolving weather conditions. Sophisticated computer simulations focus forecaster attention on areas of potentially dangerous weather. These new technologies require that we change the way we look at and observe the weather. A simple SAO, although providing vital basic information, does not accurately portray atmospheric conditions as we are now able to do using the additional observational data. ASOS was never intended to be the sole source of weather data critical to aviation. Data from ASOS are to be used in conjunction with other information to best portray the weather.

Actual performance of ASOS in an operational environment has provided insight into weaknesses and strengths of the system.

In its report on ASOS last year, the General Accounting Office (GAO) identified issues with ASOS that needed to be resolved. We recognize the concerns pertaining to the technical problems associated with specific elements of the ASOS system and are working with the respective user groups and the production contractor to solve those problems. To that end, retrofits for certain sensors are underway at commissioned ASOS sites to improve their performance and meet the needs of the user community.

To properly address the concerns of the user community, the NWS, in conjunction with the FAA and the airline industry, conducted a demonstration of ASOS capabilities at twenty-five locations nationwide. The demonstration, from February 1995 through August 1995, evaluated the effectiveness of ASOS sensors. The report is currently being completed and we will forward it to the Committee as soon as it is available. Preliminary results are promising. Availability of the data at the twenty-five sites exceeded 99 percent and the representativeness of the automated observation, that is, how well ASOS portrays the conditions present at the commissioned observing site, exceeded 98 percent.

While ASOS, as originally designed, meets NWS requirements for general weather forecasting, the NWS recognizes the need for improvements to ASOS above and beyond those original requirements. To that end, funding has been approved in the

Program's budget, and work is already underway, to increase the system capabilities. Future system enhancements include an "all weather" precipitation gage, an ice-free wind sensor, a sunshine/duration sensor, and a combination of sensors and algorithms to improve the reporting of present weather to include events such as drizzle, hail, and ice pellets.

Recently, the FAA, in consultation with the aviation industry, determined that additional information, beyond the original ASOS requirements, is required at a number of airport sites. FAA and the aviation industry are currently analyzing which airports will require this additional information. NWS and FAA expect to use observers or air traffic controllers to manually augment the automated observation with this additional information, including freezing drizzle, ice pellets, snow depth, and snow rate, as appropriate. These augmentation arrangements will remain in place until such time as new sensors are designed, developed, and added to the ASOS sensor suite, and the user community has accepted them. NWS will continue working with the FAA and the aviation industry in the development and refinement of ASOS service standards. Our goal is to implement standards that will maintain the current high level of safety while making the most effective use of precious human resources.

AWIPS

Significant progress has been made over the past year with

AWIPS. The AWIPS program was restructured last year to provide, at the earliest possible time, the system capabilities that support improved, cost-effective weather services.

In 1994, NOAA requested an independent assessment of the AWIPS program to evaluate the development direction of the program. Dr. Herbert Kottler, from MIT Lincoln Labs, headed the independent team. The team found that development in "incremental builds" is rapidly becoming the industry standard for system development and recommended that the AWIPS program follow this path for development and deployment. NWS also surveyed major private industry leaders in system development and found that the private sector is moving toward incremental builds as the architectural design of choice.

Progress has been excellent. AWIPS Pathfinders, working off the AWIPS data stream (NOAAPORT), have been installed at five locations, three of which are operational offices, and are integrated into operations at these offices. NOAA restructured the development phase of the AWIPS contract according to these recommendations of the independent team, with the contract modification for the restructured program signed last August.

The AWIPS "incremental build" approach will allow forecasters to take immediate advantage of limited capability, but highly critical, new forecasting tools, while allowing for improvements

and additional capability to be added incrementally. This approach also provides the added advantage of having forecasters gradually adapt to improved capabilities, rather than all at once. AWIPS Pathfinder, a rapid prototype that is bringing basic infrastructure to field operations, is demonstrating critical AWIPS system aspects in an operational setting, including architectural features, portions of the communications system, and operations and maintenance support. It is currently undergoing evaluation, but has already made a significant difference to the weather forecast operations in the locations where Pathfinder has been deployed.

The Pathfinder Network Control Facility (NCF) is the forerunner of the AWIPS communications hub. The NCF is a state of the art telecommunications network monitoring and control facility as well as a remote diagnostic center for weather offices and provides a 24 hour per day help desk for technical support. Site recovery and maintenance are also provided by the NCF. The Pathfinder NCF will evolve to ensure the operation of the AWIPS Communication Network and will monitor and control remotely the satellite broadcast network (SBN), terrestrial network, and site status.

A significant aspect of the NCF was demonstrated in November 1995 when a Pathfinder software upgrade was successfully installed remotely from the NCF to the sites. The NCF is further

opening up NOAA's hydrometeorological data stream to the private sector. The SBN feeds NOAAPORT, through which users will access data. For the first time, the private sector can obtain real-time, formatted, high resolution images from GOES.

Development of AWIPS is progressing rapidly. Planning Research Corporation, the contractor, recently conducted a detailed design review of the first of the incremental AWIPS build. No problems were found to prevent PRC from moving ahead with coding and testing the build 1 software. We have been pleased with the level of interaction between PRC and the Government in the area of software design.

Assuming the availability of funding, we plan to install AWIPS at several field sites this spring. This limited deployment will allow us to conduct an Operational Test and Evaluation (OT&E) of AWIPS that will demonstrate the available operational capabilities of the system and establish confidence that the system will achieve the objectives laid out for the NWS modernization.

The National Research Council's NWS Modernization Committee will lead an independent assessment of the methodology, conduct, and results of the AWIPS OT&E. They will review the plans for the OT&E to ensure that established criteria are met, monitor the actual testing to ensure that it is consistent with the plans,

and review the results and related actions.

NOAA has worked extensively to estimate the time required for AWIPS development, including estimates of software lines of code, advancements in development environments and development and test tools, and experience of program personnel. Experience with Pathfinder provides useful input to this task. NOAA acknowledges that there is some technical risk of schedule slip due to the overlap of certain development steps, but believes the aggressive AWIPS schedule is achievable.

While additional capabilities will be added after the national deployment of AWIPS, NOAA believes that this strategy does not represent a large risk. Rather, NOAA believes it is more prudent to proceed with nationwide deployment to begin capturing both the benefits and the experiences from operational use that cannot be obtained in a test bed or at a limited number of sites.

A draft General Accounting Office report, prepared for this Committee, raises concerns that the NWS has not fully justified all of AWIPS' capabilities. The NWS continually investigates modernized operations to validate planned operational procedures, refine and test proposed system capabilities, gain insight into required staff resources, and assess service impacts. These investigations have employed prototypes of system capabilities in

operational settings that simulate the modernized era. These activities have yielded valuable information with which to shape modernized operations.

NOAA continues to work to achieve the benefits of the NWS modernization and associated restructuring in an aggressive, but responsible, manner. Any delay of the transition to AWIPS-based operations would adversely impact the ability of the NWS to capitalize on the investments in the modernization thus far, and prolong the costly labor-intensive, interim operations dependent upon an outdated AFOS system. Operational forecasters would not be able to make effective use of the advanced observational data and central guidance products that are now available. Outyear budgets reflect planned savings; delays would require additional resources.

NWS STAFFING

The then Secretary of Commerce presented the Strategic Plan for National Weather Service Modernization and Associated Restructuring to the Congress at the beginning of Fiscal Year 1989. The final plan reduced the number of permanent NWS staff by 1,000 from the on board employment level at that time of 4,750 employees down to 3,750 (or 5,100 FTEs to 4,028 FTEs, respectively). This included an agreement to significantly reduce the headquarters elements of the NWS. This became known as the "end state" modernization target level for NWS staffing.

Since this staffing target was established more than six years ago, a number of factors have affected the planning premises on which the staffing reductions were based. For example, the strategic plan originally assumed that the maintenance and repair of new NWS field systems would be performed by private contractors. This allowed a significant reduction in the need for NWS in-house maintenance staff and associated training activities. However, in subsequent cost-comparison studies, it was determined that the cost of maintaining the new systems and conducting associated training activities was significantly less if performed by in-house NWS staff. This cost-driven determination is consistent with the Office of Management and Budget's requirement to achieve greater savings. This adjustment, however, added more than 180 FTEs to the end state staffing target level.

Other changes have occurred in the modernization that have necessitated adding back FTEs to the end-state targeted staffing level, such as the addition of new weather forecast offices (WFO), additional NEXRADs, as well as changes to the maintenance philosophy for the systems. Some further adjustments, both up and down, to the end-state staffing level are likely to occur as we move forward to completion.

NOAA has incorporated the planned staffing savings of the NWS modernization and associated restructuring into its current

Streamlining Plan. The NWS is also well on its way to reducing staff to meet the modernization staffing targets in its headquarters and centralized operational elements. These staffing targets incorporate the recent efforts to reduce various headquarters staff, organizational layers, and supervisory personnel.

The NWS modernization is a complex task that will produce a streamlined NWS organization with a significant reduction in FTEs. With implementation well underway, the modernization and associated restructuring of the NWS is just past its mid-point and it is more crucial than ever to stay the course.

A strong commitment from the Congress and the Administration is necessary to ensure that weather service modernization is completed in a timely fashion. Last year, several proposals were passed in the House of Representatives, including the Budget Resolution and the DOC Dismantling Act, which would have seriously jeopardized this goal by providing insufficient funds both for current operations and most aspects of the modernization. In order to fund the modernization, NOAA would have been forced to eliminate other services and programs of great value to the Nation, including the type of research conducted by NOAA which made the modernization possible, and which now is enabling NOAA to forecast seasonal climate variations. It is important to recognize that NOAA is working to

reduce costs associated with the provision of weather services. For instance, the convergence of civilian and military polar-orbiting weather satellites is expected to save up to $1 billion over the life of the program.

In addition, the new technologies and hydrometeorological science associated with weather service modernization are providing unprecedented opportunities for developing new and productive relationships between the NWS and other activities in NOAA. New satellites are providing data important to the preparation of seasonal climate outlooks, and climate data is now being studied by fishery scientists to understand better the role of climate in affecting ocean primary productivity and the health of fisheries.

CONCLUSION

The next several months will see several major accomplishments. We have every expectation of reaching final agreement with the FAA on an ASOS augmentation/backup requirement to meet aviation community service standards. The last of the "original" NEXRADs will be delivered in July. We will occupy 110 of 118 new weather offices. And we plan to reach the key decision point in the AWIPS program to proceed with national deployment.

We must continue with the modernization to provide the most advanced weather services to all parts of the Nation, to begin to reap the substantial economic benefits these services bring, and to produce a streamlined NWS organization.

This concludes my testimony, Mr. Chairman. I will be pleased to answer any questions you might have.

Mr. ROHRABACHER. Thank you, Dr. Baker.
Mr. DeGeorge.

STATEMENT OF MR. FRANK DeGEORGE, INSPECTOR GENERAL, UNITED STATES DEPARTMENT OF COMMERCE

Mr. DEGEORGE. Mr. Chairman, our office has had a long and continuing interest in the National Weather Service's $4.5 billion program to modernize its observing and information systems. I personally have been involved in it for about the last 10 years as well.

We have been heavily involved, and we've had many reports, and basically a general amount of discussions.

The improvements that we have worked on together with the weather service, I think, have been substantial. In some of the areas, such as spare parts, acquisitions and contractors, substantial savings have been accomplished.

We've also provided the Department and NOAA with technical and legal advice relative to acquiring NEXRADs, AWIPS, et cetera. As we now know, there are now 105 National Weather Service satellites, and two GOES satellites successfully operating.

However, AWIPS development over the years, as difficult as it has been, and as much as has been accomplished, has been accompanied by serious cost growth, schedule slippages, management changes, and lack of, I think, substantial technical progress.

As the chart on page 4 of my testimony states, in 1986, the National Weather Service estimated that the program would cost $350 million and be accomplished by 1995. As of '95, the estimate is now $525 million, and I believe costs will continue to rise.

Since 1992, AWIPS has had four different program managers, and has undergone two basic routes of restructuring. And even as of this moment, I think that the AWIPS program is even behind its 1995 recent schedule.

Over the past four years, we have completed three separate evaluations of AWIPS, which have identified serious and recurring problems.

In our first evaluation during the 1992 restructuring, we found that NOAA's solicitation of the AWIPS development contract was incomplete, disorganized, and ambiguous. We recommended that changes be implemented. Those changes, simply put, were disregarded in the name of timing.

I believe NOAA and the weather service felt that they had to get moving, and they didn't have enough time to improve the contract, because it was not, in my judgment, adequately prepared, and contained some inappropriate incentives for acceleration.

AWIPS experienced immediate and persistent problems even after the contract was awarded. These problems, while disappointing, were not surprising. So we conducted a second evaluation.

Incidentally, Mr. Chairman, we have these three evaluations and they are before you and any Congressional members or staff who wish to see them here. We found that efforts to solve problems in AWIPS had been impeded by moving, in my judgment incorrectly moving, the responsibility for the AWIPS procurement process back to the weather service.

We concluded that NOAA had not developed a realistic schedule or an effective approach. Because of the problems, and because the

program did continue to languish to some extent, the contract was again renegotiated in August of 1995 with an additional cost increase of $68 million.

Modifications for deployments operations are yet to be negotiated. The contract renegotiation and technical issues prompted our third evaluation, which was completed this month, and which, as we summarized in my statement, we found that NOAA intends to press the Secretary of Commerce to make the production decision which will allow deployment of AWIPS nationally to 140 sites before even half of the software has been developed, and before, in my opinion, it has conclusively demonstrated that AWIPS can replace the existing AFOS hardware.

This means that NOAA will probably be investing well over $100 million in computer and other auxiliary equipment hardware at sites, state of the art, but with a strong possibility, in my opinion, that within a couple of years, it will be changed.

Our principle concern is that, when all the necessary software is developed, the installed hardware may not be up to the adequacy of doing the job at that point. I might point out that the programming will probably go on, if not for the next two years, indefinitely.

The weather service does an extraordinary job in developing products. And I do think that having equipment out there now will slow that down. I think they will continue to find necessary needs. And as those needs grow, the computer capacities and hardware capacities, hopefully, will grow, in my judgment.

Moreover, with hardware costs continually dropping, and performance steadily improving, rushing unnecessarily to purchase or release the hardware for this 140 sites is at least a debatable issue in my point. Better and cheaper hardware will probably be available.

Our concerns have nothing to do with the big bang method, which we do not advocate at all, or have never suggested, or with any opposition to incremental software development, which we do not fight.

What we object to is in the nationwide deployment of millions of dollars of hardware for a system that, in our judgment, lacks the fundamental capacities to support weather service operations in its current mode. We have less than 20 percent of the software developed. Yet we would release it in August, and I don't think we'd be up to 50 percent of the software developed.

I don't care what incremental approach you want to take. They are numbers that would slow my procurement process down.

In the latest restructuring, the production decision was scheduled for October '96. This is what was negotiated several months ago. Since the time of our evaluation, despite the fact that there has already been a five and a half month slip in the program schedule in the last six months, NOAA has decided to again advance the date to August of this year.

In our view, NOAA will not be demonstrating a system at all, but rather a limited collection of disparate capabilities.

I'm sympathetic with the desire to have equipment that the weather forecasters can use. And I applaud the job that weather service has done. However, I have one basic disagreement. I see no reason to move as fast on the release of the procurement process

as they are prepared to do. No pain, no cost in my mind, no technical judgment, will be lost if, in effect, we delay that decision until more of the software is developed.

While we argue with the weather service as to the capability of AFOS, I would point out that right now we vacated the 130 or 140 offices using the AFOS capability. I'm not suggesting for one moment that AWIPS is not needed. I think it is vital. What I am suggesting is that we've learned how to live with it. And even by the weather service's measure, what they have in the way of products today is many-fold times what they had five years ago.

I really feel as intensely as this seems to sound. But in effect, we're arguing over a relatively small part of the process, but an important part of the process. Is AFOS enough to take us to the point where we can substantially develop, reduce as many risks as we can in the development of the software using any software development you have?

If you must do it, that's one thing. I do not believe it is a must-do call, and will so advise the Secretary.

Turning now to certification and field office closure issues, I continue to oppose the legislative requirement for certification. It's an academic exercise anymore. Almost all the offices are vacated. I see no reason to continue this charade that these offices have people in them, other than observers for the weather service.

We don't have those people. You cannot argue any longer that closure of an office must be only conditioned with AWIPS, because you've closed almost all the offices so far, using AFOS. We have also done other work recently that deals with weather service staffing, principally in the 1,000 people or so that basically support directly the non-field staff of the weather service.

We've recently issued a draft report, which I will finalize in the next couple of days, that strongly suggests the weather service should make reductions in its Silver Spring staff. We have waited long enough to do that.

And one final point. The argument has been made that SPO, the strategic procurement office, of which I was a strong advocate, did not work. I strongly disagree with that. I think the biggest mistake we've made is to break the acquisition process into two responsibilities.

I would more properly argue at this point in time that the weather service should be given back the responsibility of completely controlling its systems acquisition, than in effect, to keep two separate disparate duplicate of operations for the procurement process which we have today.

I repeat. I believed in the SPO initially. Once it was given only acquisition responsibilities and separated for all intents and purposes from the program management capability, we have created two staffs. And here I strongly agree with Joe Friday. The responsibilities under those circumstances should probably be moved back to the weather service. It should also result in substantial savings and reductions of staff.

I'll be glad to answer any questions, Mr. Chairman.

[The prepared statement of Mr. DeGeorge follows:]

Insert #2 T. 2

UNITED STATES DEPARTMENT OF COMMERCE
The Inspector General
Washington, D.C. 20230

Testimony
of Frank DeGeorge, Inspector General
U.S. Department of Commerce

before the
Subcommittee on Energy and Environment
Committee on Science
House of Representatives

February 29, 1996

Mr. Chairman and Members of the Subcommittee:

I am pleased to be here today to discuss the National Weather Service modernization with you. I will briefly cover some background on the modernization and our involvement and then will discuss our most recent evaluation of NOAA's progress on the Advanced Weather Interactive Processing System (AWIPS). I will also address NWS field office closures, the legal requirement for certification, and headquarters staffing issues.

We have had a long and continuing interest in NWS's $4.5 billion program to modernize its observing and information systems and to reduce more than 250 field offices to 119. This office has been heavily involved in trying to improve the planning and management of the modernization and in securing improvements in a number of areas. We fostered the establishment of a management organization, the Systems Program Office (now the Systems Acquisition Office), with the objective of having a qualified and experienced acquisition workforce acquire the modernized systems. That office was effective initially, reversing the substantial cost growth, schedule delays, and technical performance problems of the new radars (NEXRAD) and satellites (GOES-Next), although it no longer has the influence, authority, or resources that were intended. There are now 105 NEXRAD radars and two new GOES satellites operating successfully.

We provided the Department and NOAA with extensive management, technical, and legal advice in the renegotiation of the NEXRAD prime contract; identified overcharging for NEXRAD spare parts; and worked with NOAA to improve spare parts procurement, resulting in savings of $39 million.

Other important areas still need to be addressed, however. NOAA continues to promote unrealistic expectations about progress on AWIPS and to take unwarranted risks with its development. NOAA also continues to drag its feet on field office closures and to advocate unnecessary certification requirements. Also, NOAA inaccurately asserts that staffing cuts will adversely affect field forecasting operations without giving serious attention to streamlining opportunities available in its headquarters and support operations. We have been less involved in reviewing the Automated Surface Observing System, ASOS, which is being fielded and commissioned, but still has sensor problems in need of correction. Moreover, contrary to NWS's original goal of eliminating the human observer, this system requires and will continue to require human involvement in its operation at certain sites.

I would like to discuss AWIPS in some detail because of our serious and longstanding concerns with this program.

AWIPS

AWIPS is intended to replace the antiquated Automation of Field Operations and Services (AFOS) system, which processes meteorological data and distributes it to NWS field offices and other facilities. AWIPS will provide the capability to acquire data from the advanced observing systems coming on-line and to provide forecasters with tools to rapidly analyze the data, integrate it with the information provided by the weather service guidance centers, and prepare timely and accurate warnings and forecasts for dissemination to the public and the media. AWIPS is the key integrating element of NWS's modernization program and is essential to achieving weather service operational improvements and resultant staff reductions. Thus, it is of the highest priority.

However, AWIPS development has been characterized over the years by substantial cost growth, protracted schedules, management instability, and sluggish technical progress. The cost growth and schedule delays are depicted on the next page. In 1986, NWS estimated that the program would cost $350 million and be completed in 1995. After extensive restructuring in 1992, the estimate grew to $475 million, with a completion date of 1998. As of 1995, the estimate became $525 million, with a 1999 completion date. While the previous estimate included a $40 million contingency, the new estimate did not, resulting in actual projected cost growth of $90 million in just two years. This office has every expectation that AWIPS will have a final price tag exceeding $600 million and a completion date sometime after the turn of the century. In fact, if current trends continue, AWIPS could take twice as long and cost twice as much as originally planned.

Since 1992 alone, AWIPS has had four different program managers and has undergone two major rounds of restructuring. "Restructuring" is the term used when extended schedules, increased costs, and reduced technical performance become officially recognized and approved. Although the latest round of restructuring has scarcely been concluded, AWIPS is already falling behind its new 1995 schedule and is currently revising its cost estimate upward. As discussed below, these problems, while disappointing, are not surprising.

We conducted two previous evaluations of AWIPS and have just completed our third. In our first evaluation, conducted during the 1992 restructuring, we found that NOAA's solicitation for the AWIPS development contract was incomplete, disorganized, and ambiguous.[1] We concluded that the solicitation (1) would lead to a contract that would be difficult to administer and to disputes that would be difficult to resolve, (2) would not form the basis for an enforceable contract, and (3) did not provide for a coherent engineering process. We recommended that NOAA thoroughly review and revise the solicitation prior to contract negotiations with the objective of obtaining a clear, complete, consistent, and enforceable contract. NOAA did not

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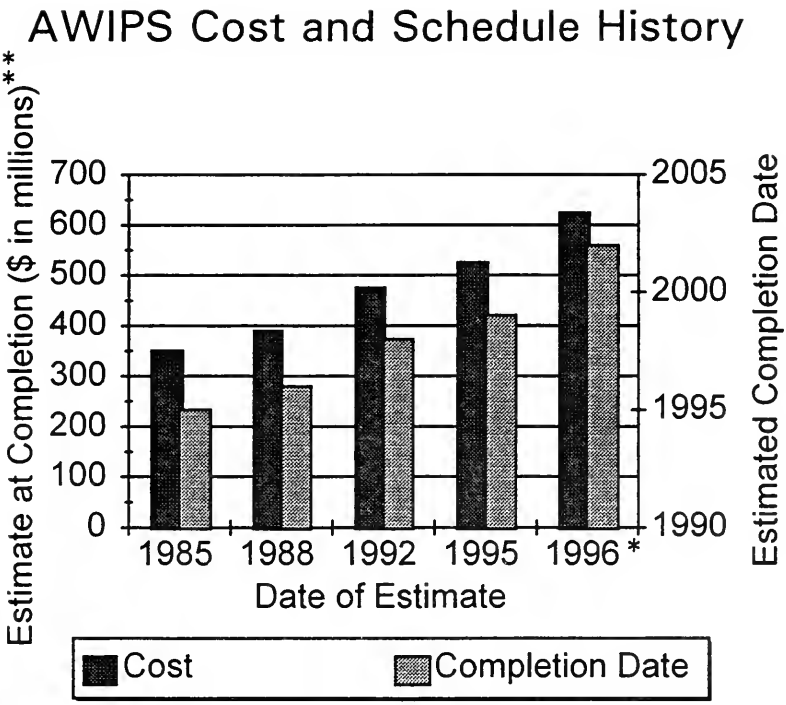
[1] *AWIPS Re-Baselining and Associated Issues,* U.S. Department of Commerce, Office of Inspector General, Report No. SED-4585-2-0001, May 1992.



* OIG estimate. All others are NWS estimates.

** Costs are in current-year dollars.

implement our recommendations, stating that the schedule would permit no further delays. Indeed, NOAA considered the delays it was already experiencing a major mission concern, which it dealt with by awarding the development contract as quickly as possible and by including a large contractual incentive to accelerate the development schedule.

Our evaluation also found that NWS had not adequately justified its minimum requirements for AWIPS. In response, NOAA took the position that it was up to its experts to make requirements decisions and provided no additional requirements information or rationale. As a result of NOAA's unwillingness to justify its requirements, questions about their validity remain, causing GAO to raise this issue again in its recent evaluation.

AWIPS experienced immediate and persistent problems after award of the development contract in December 1992, leading to our second evaluation, which concluded that the nearly two years spent on AWIPS development had yielded little technical progress.[2] In addition to the problems cited in our first inspection, we attributed this to an environment of inordinate NWS-imposed schedule pressure exacerbated by an inappropriate contractual incentive for schedule acceleration and entering the development phase prematurely, without a system design.

We also found that efforts to solve problems on AWIPS had been impeded by NOAA's realignment of organizational responsibilities. Specifically, control of the acquisition had been transferred from the Systems Acquisition Office to NWS, which lacks the capability to effectively manage major systems acquisitions. We concluded that NOAA had not developed a schedule or an approach to AWIPS that was responsive to the management issues.

Because of the problems with AWIPS, the contract work could not be performed and the program was again restructured. A renegotiated contract for AWIPS development was signed in

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[2]*Management and Engineering Problems Halt AWIPS Progress*, U.S. Department of Commerce, Office of Inspector General, Report No. SED-6623-4-0001, September 1994.

August 1995 with a cost increase of $68 million. Modifications for deployment and operations must also be negotiated. The contract renegotiation and the technical issues on AWIPS prompted our third evaluation.[3]

We found, in brief, that NOAA intends to ask the Secretary of Commerce to make the AWIPS production decision and to deploy the system nationwide before it has conclusively demonstrated that AWIPS can replace AFOS, placing many millions of dollars at risk. We also determined that NOAA's accelerated AWIPS schedule is unrealistic and, we believe, cannot be achieved. Although NOAA maintains that AWIPS must be deployed quickly because of the fragile condition of AFOS, we found that AFOS, augmented by other meteorological systems, can continue to support NWS operations at least to the year 2000. Finally, we found that NOAA can close field offices now without AWIPS and therefore can expedite office closures.

I will discuss our findings in more detail below.

NOAA's plan for the AWIPS production decision adds risk

According to NOAA's plans and consistent with OMB policy for acquiring major systems, NOAA must request the Secretary of Commerce to make the AWIPS production release decision. The production decision means that the system has been satisfactorily tested under operational conditions and has been proven to be able to do the job for which it was built. At that point, the system can be fully deployed. This decision is important for AWIPS because it permits NOAA to invest well over $100 million to deploy AWIPS hardware nationwide to 140 sites. Therefore, at the time of the production decision, NOAA should be able to conclusively demonstrate that AWIPS has the functional capability to at least replace AFOS. At the time of our inspection

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[3] *Unrealistic Schedule and High-Risk Decisions Continue to Jeopardize AWIPS Success*, U.S. Department of Commerce, Office of Inspector General, Report No. OSE-7355, February 1996.

several months ago, NOAA intended to request this decision in October 1996. It has since decided to seek this decision in August 1996.

However, we found that NOAA plans to seek the production decision with less than half of the AWIPS software completed and the system being far from able to replace AFOS. Consequently, NOAA will not be able to demonstrate that AWIPS' performance is satisfactory and thus intends to invest many millions of dollars in hardware for an unproven system. When all of the necessary software is developed, the hardware may not be adequate to do the job and could be obsolete and out of production, requiring the procurement of new hardware or the inability to use all planned capabilities. With hardware costs continually dropping and performance steadily improving, rushing unnecessarily to purchase hardware for 140 sites is simply bad business. Such acceleration not only increases the likelihood that the hardware will be inadequate and obsolete, but also prevents NOAA from taking advantage of the fact that better and cheaper hardware will probably be available later—when AWIPS is mature enough for full deployment.

NOAA has recently begun to recognize the lack of progress on AWIPS development and to plan for delays, while still maintaining that its schedule is realistic and achievable. In the six months since the development contract modification was signed, there has been a 5-1/2-month slip in the software development that was planned for the production decision. Despite this problem, NOAA has decided to advance the date of the production decision by two months to August 1996 and to further reduce the capabilities that will be demonstrated. If permitted to proceed in this way, NOAA will demonstrate a system that is even less capable than the one we strenuously objected to in our evaluation. In fact, in our view, NOAA will not be demonstrating a system at all, but rather a limited collection of disparate capabilities. Such a milestone would have no meaning and would be extremely risky.

NOAA argues that it has advanced the date in order to allow more time for operational test and evaluation. However, such test and evaluation is of little value on a system lacking fundamental capabilities to support weather service operations. In addition, NOAA has not yet even prepared

an operational test and evaluation plan, nor has it determined precisely what will be developed and available for demonstration at the time of the August milestone. Thus, we do not accept the rationale for moving the date forward.

NOAA had always planned for the production decision to be made *after* it had conclusively demonstrated that AWIPS could replace AFOS. However, with the slow progress on AWIPS, NOAA would not be able to request the production decision until 1998 if it were to wait for the functional capabilities of AFOS to be available. NOAA recently changed its plans, we believe, because AWIPS is far behind schedule, with meager progress made since contract award in December 1992. Therefore, this program is under intense pressure to demonstrate results. Having a production decision as planned by NOAA would be an unacceptable risk even for an organization with a strong track record in developing and acquiring systems, and NOAA has no such track record.

NOAA argues that our position on the production decision prevents it from using a modern incremental software development approach, forcing, instead, the use of archaic and disproven methods. We disagree. We believe an incremental approach can be effective if it means developing and testing carefully planned software increments using a realistic development schedule and applying the lessons learned on earlier increments to improve performance on later ones. Unfortunately, to NOAA, it means developing numerous software increments as quickly as possible with as much parallelism between increments as resources permit, and not planning for adequate durations to manage and control development activities.

Our position that AWIPS should have the functional capabilities to replace AFOS at the time of the production decision is totally consistent with incremental development. AWIPS can be developed on a sound schedule and tested at a limited number of sites in the field, increment by increment, until AFOS-equivalent capabilities are available and proven. However, the increments that comprise the production decision should have no less than the functional capabilities to replace AFOS. In our view, NOAA is not using this methodology responsibly, but as a device to

justify an inappropriately accelerated schedule. NOAA's acceleration of the production decision milestone with further reduced capability is a giant step in the wrong direction.

NOAA's accelerated schedule for AWIPS is unrealistic and risky

Our evaluation found NOAA's schedule for AWIPS to be arbitrary, unrealistic, and not achievable. That is, we found not only that NOAA planned to request the production decision prematurely, with inadequate capabilities completed, but also that it could not possibly develop the capabilities that it intended to demonstrate by October 1996, nor could it develop the capabilities needed for AFOS replacement by 1998 and for personnel reductions by 1999, as planned in its newest schedule.

NOAA established its unrealistic schedule by planning to perform software development activities simultaneously that should be performed sequentially, compressing the time to complete development activities, removing critical activities from the development process, and altering key parameters of its scheduling tool to artificially yield a shorter development time frame. As such, NOAA did not use sound management or engineering judgment in arriving at its schedule.

NOAA contends that we exaggerate the schedule risk, but as I have pointed out, AWIPS development activities are already falling behind the 1995 restructured schedule. The current delays are associated with high-level and detailed design activities, and we expect further and more serious delays as AWIPS development moves into coding and testing, where problems and errors are much more visible and must be corrected. NOAA's experience on Pathfinder[4] illustrates why we expect significant delays. The software architecture for the Pathfinder's weather forecasting applications is much simpler than AWIPS, which uses a very sophisticated and complicated client/server architecture. Therefore, the software design issues on Pathfinder were much simpler. Moreover, unlike AWIPS, Pathfinder was on schedule during both the high-

[4]Pathfinder is a prototyping activity used to implement, deploy, and operationally test selected AWIPS capabilities.

level and detailed design phases. Nevertheless, NOAA still experienced schedule growth of about 30 percent on Pathfinder due to coding and testing problems.

We believe that the schedule is driven by NOAA's concern that a longer timetable would jeopardize program support and funding. As with its approach to previous AWIPS schedules, NOAA has again decided on a timetable that is neither realistic nor achievable. And like previous AWIPS schedules, this schedule will lead to a breakdown of development discipline, minimizing such activities as testing, documentation, and reviews and leading ultimately to higher costs and further delays.

We strongly disagree with NOAA's position that the AWIPS schedule is a philosophical issue. Unrealistic schedules lead to the very concrete problems of inefficient resource use and millions of dollars of waste. Experience has shown that in trying to meet unrealistic schedules, developers must cut corners and skip steps in the development process, compromising accuracy and quality and leading to excessive errors and expensive rework. Inadequate development times mean reduced testing, more unidentified errors, and increased costs. The schedule acceleration incentive that contributed to the collapse of the original AWIPS development contract is an unfortunate example of the futility of unrealistic schedules. NOAA's schedule, in our opinion, will perpetuate the cost, schedule, and technical performance problems that have plagued AWIPS since development began. We continue to maintain that AWIPS plans should be based on sound technical and management factors that yield a realistic, achievable schedule, rather than on arbitrary directed deadlines.

AFOS can continue to support NWS operations, making AWIPS acceleration unnecessary

NWS officials state that AWIPS must be deployed quickly because operations will be harmed by the fragile condition of AFOS, its inability to provide field forecasters with improved meteorological data, and its inability to visually integrate and overlay meteorological data. Our analysis of the current operational condition of AFOS and the availability of new data does not

confirm this view. Since AFOS became operational in 1982, NWS has made numerous enhancements to increase the system's capability, maintainability, and reliability. We found that current NWS operations are being successfully performed using AFOS augmented by other meteorological and sensor systems. Although NWS cannot yet take full advantage of its new satellite and model data, field offices now have access to data that is dramatically better than that available just five years ago. However, if NOAA can demonstrate that providing the new satellite and model data to field offices before AWIPS is ready is justified, it should identify interim solutions that are cost effective and do not place AWIPS dollars at risk. Furthermore, we believe operations can be supported by AFOS at least to the year 2000 with no degradation of service. Although AFOS must clearly be replaced with a modern system to improve operations and supportability, there is no need for NOAA to take a high-risk approach to AWIPS implementation.

Certification is unnecessary and expensive

We continue to oppose the legislative requirement for certification. Currently, Public Law 102-567 requires the Secretary of Commerce to certify that there will be no degradation of weather services to an area as a result of a field office closure. In our 1993 report on this topic, we pointed out that it is both ineffective and uneconomical to maintain staff and old offices that should be closed when services can be provided more effectively by new offices.[5] We recommended that the law be amended to permit NWS to close old offices sooner, thereby freeing up staff and other resources that can be put to better use in the new offices. We restated our concerns and recommendations to this Committee this past summer.[6]

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[5]*Legislative Requirements Impact the Timeliness of the National Weather Service's Plans to Open and Operate New Weather Forecast Offices*, U.S. Department of Commerce, Office of Inspector General, Report No. ADD-4524-3-0001, September 1993.

[6]Letter to The Honorable Robert S. Walker, Chairman, Committee on Science, House of Representatives, from Francis D. DeGeorge, Inspector General, U.S. Department of Commerce, dated June 19, 1995.

When the certification requirement was first enacted in 1988, the effectiveness of Doppler weather radar technology had been proven, but had not yet been used in operational environments. Since then, 105 NEXRAD radars have been installed and are operating successfully. Furthermore, the National Research Council, in a recent report on its assessment of NEXRAD coverage and associated weather services, concluded that weather services on a national basis will be improved substantially under the currently planned NEXRAD network.[7] Although the report identified five locations where potential for degradation in radar-detection/ coverage capability exists, it pointed out that degradation of such coverage does not necessarily mean degradation of weather services. The report also provides a process for dealing with these locations, which NWS is following. Clearly, certifying the closure of hundreds of old offices nationwide is an unnecessary and outmoded concept, particularly in light of the NRC's findings.

Even with the certification requirement, NOAA has placed an unnecessary roadblock in the way of office closure. NEXRAD radar coverage is the key factor that makes office closure feasible, permitting the functions provided by the field offices slated for closure to be transferred and allowing these offices to be closed. While the law requires that the Secretary of Commerce certify that there will be no degradation of service in an area as a result of field office closure, NWS establishes the criteria for assessing whether services are degraded. According to NWS's criteria, in most instances, an office cannot close until after the commissioning of AWIPS and the decommissioning of AFOS at a WFO that will provide the services formerly provided by the closed offices. Thus, NOAA has made AWIPS availability a condition for closure of most offices, leaving the time frame for closure uncertain and any cost savings delayed and diminished.

NOAA asserts that field offices cannot be closed without AWIPS because of the limitations of AFOS and because these offices continue to be an integral part of the NWS structure and a vital

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[7] *Toward a New National Weather Service—Assessment of NEXRAD Coverage and Associated Weather Services,* NEXRAD Panel, National Weather Service Modernization Committee, Commission on Engineering and Technical Systems, National Research Council, June 1995.

link to the communities they serve. However, we found that AFOS, combined with supplementary data and systems already used in the field, can sustain operations without degradation of service. In addition, the community functions performed by the field offices to be closed are independent of AWIPS and will eventually be performed at permanent forecasting offices. Therefore, NOAA should establish policies, procedures, and schedules to expedite transfer of those responsibilities. Further, NOAA should identify alternative approaches, such as re-routing local communications circuits, to allow office closure in the absence of AWIPS. Any offices that need to stay open because of unique circumstances should be justified on a case-by-case basis.

Although NOAA agreed to review its plans for office closure and intends to begin closing some offices, it would not commit to producing a plan and schedule for closing offices that can be closed before AWIPS is available.

NWS should streamline its headquarters and support operations

In response to budget pressures, NWS contends that any budget cuts would require a reduction in field operations staffing, thereby compromising its ability to provide forecast and warning services and jeopardizing completion of its modernization program. However, this contention is not supported. While NWS has prepared detailed plans for consolidation and restructuring of field offices, it has not conducted rigorous analysis and planning to streamline its headquarters and support operations, which comprise more than 1,000 employees. Therefore, it lacks an analytical basis for asserting that weather services would be curtailed if budgets are cut.

We conducted a review to identify potential areas for streamlining NWS headquarters in light of the modernization and restructuring, proposed budget cuts, and the National Performance Review workforce downsizing initiative. Our review identified areas in NWS's headquarters and support operations where we believe streamlining may be possible without detrimental effects. We found 258 positions that NWS should seriously review for elimination and another 187 positions that it

should evaluate for contracting out, restructuring, and potential elimination. Savings gained could be used to maintain NWS's field operations. NOAA should consider, in particular: (1) consolidating the employees dispersed between NWS and the Systems Acquisition Office who are involved in AWIPS development, (2) merging system support offices, (3) eliminating the unnecessary liaison and transition functions, (4) reducing the 1:6 ratio of support staff to program staff, (5) reducing non-technical information support staff, (6) confirming the need for a centralized training center, (7) pursuing options for in-house telecommunications network control facilities, and (8) seeking alternatives to its dispersed logistics functions.

Conclusion

Many aspects of the modernization are going well, but serious problems and issues remain. NOAA is rushing to field AWIPS prematurely because the new system promises vast improvements over AFOS and because the agency is under intense pressure to show progress on this program. However, without a credible schedule, we lack confidence that AWIPS can be delivered without continuing cost growth and delays. The risky schedule will only perpetuate and intensify the problems on AWIPS, regardless of its urgency or importance. In these lean budget times, it is imperative that NOAA pursue a responsible course of action on AWIPS. It is also imperative that NOAA secure savings in areas that will minimize any negative effects on NWS operations—by accelerating the closure of unnecessary field offices and by making meaningful reductions in staffing at headquarters and in support operations. With over 1,000 employees in these areas and without a serious attempt to streamline them, the argument that NWS budget cuts will compromise warning and forecast services is just not acceptable.

Mr. Chairman, thank you for the opportunity to share my thoughts today on this important subject. I would be pleased to answer any questions that you might have.

Mr. ROHRABACHER. Thank you very much, Mr. DeGeorge.

Dr. Baker, you will have a chance to confront some of the challenges that have been hurled in your direction. And we're all looking forward to your reaction.

Just one question before we move on to the next witness. That first study you did in 1992, was that when it was released, did you say?

Mr. DEGEORGE. We have copies of the three studies.

Mr. ROHRABACHER. The study in 1992 dealt with what years?

Mr. DEGEORGE. Up to the '92 period.

Mr. ROHRABACHER. Was it the '85 to '92 period?

Mr. DEGEORGE. Roughly speaking, yes, sir.

Mr. ROHRABACHER. Dr. Baker, when did you take over your current position?

Dr. BAKER. I took over my position in May '93.

Mr. ROHRABACHER. So not all of that was hurled at you.

[Laughter.]

Mr. ROHRABACHER. Although we do expect you to answer some of it.

I'd like to acknowledge the presence of our current distinguished Chairman of the Science Committee, Mr. Bob Walker.

Mr. Walker, would you like to make an opening statement or anything else at this point?

The CHAIRMAN. I thank you, Mr. Chairman. I have no opening statement at this point. I will have some questions later. Thanks.

Mr. ROHRABACHER. Mr. Zygielbaum.

STATEMENT OF MR. ARTHUR ZYGIELBAUM, SENIOR MEMBER OF THE TECHNICAL STAFF, OBSERVATIONAL SYSTEMS DIVISION, JET PROPULSION LABORATORY, CALIFORNIA INSTITUTE OF TECHNOLOGY

Mr. ZYGIELBAUM. Mr. Chairman, I'm delighted you took care to pronounce my name. Usually I'm just proud when it is spelled correctly.

I'm honored to have been invited to testify before this subcommittee. I'm an engineer by training. I specialized in information systems. During my nearly 28 years at the Jet Propulsion Laboratory, I've developed computer hardware and software, managed JPL Science Information Systems Office, and was Deputy Manager of the Information Systems Division.

Last month, I completed a six-year appointment to the National Research Council, the National Weather Service Modernization Committee, where I chaired the panel on AWIPS.

I also took part in an independent review team recently, looking at the AWIPS application software development.

I do want to emphasize that I'm testifying as a private citizen. My comments do not necessarily reflect the views of the Jet Propulsion Laboratory, nor of the National Research Council.

Let me state my opinion on AWIPS right up front, with four points. First, AWIPS is a significant and necessary part of the weather service modernization. Second, AWIPS' development process, while it's been severely troubled in the past, has made significant improvements.

Third, AWIPS project resources may be wasted by responding to unreasonable oversight organization recommendations. And fourth, the need for AWIPS is real, and it's immediate.

I made a surprise visit last Friday to the Los Angeles Weather Service Forecast Office in Oxnard to refresh my memory on these systems. It's been awhile since I'd seen them. I was impressed once again with the skill and the dedication of the people that are out at the weather service station. I was also impressed that AFOS failed. We watched—as I sat there, as they prepared the evening forecast. I was told that it's not unusual for AFOS to fail several times during a shift.

The visit reinforced observations that the size of the observational staff and the accuracy of predictions and warnings are affected by the confusion caused by many different computer interfaces, the resource competition forced by the limited number of displays available, the complexity caused by a hodgepodge of different data formats and types, and the unreliability of AFOS.

As an engineer, let me put AFOS in context. This is a run-of-the-mill laptop computer. It's a 486/75. Five of these—I'm stretching the analogy, of course—but five of these, if they could be added together, equal the capability of the AWIPS work station. It would take 90—nine-zero—AFOS computers to match this laptop.

I think my microwave oven is probably smarter than AFOS.

[Laughter.]

Mr. ZYGIELBAUM. AWIPS is sorely needed. It's needed to improve reliability, to integrate data in several forms, on a single work station, and to automatically generate text for forecasts and other products.

Technically, AWIPS is well-founded. It's based on developmental and operational experience with the Pathfinder, and with WFO Advanced. Both systems are on display in this room. Pathfinder has minimal AWIPS functionality, and is in use and well-accepted at three sites. WFO Advanced, which will be installed this summer at the Norman and Denver weather service forecast offices, has most of the capability of AWIPS.

AWIPS hardware is based on modern work stations. The software development process, the incremental process, is a modern and correct process. I'll note in passing that the AWIPS development process has been hampered in the past by difficult relations amongst the weather service, the Systems Procurement Office, and the PRC.

The situation has improved dramatically and visibly by effectively integrating development organizational activities.

I do have concerns about AWIPS. I emphasize that my concern is not with the ultimate success of the current AWIPS project, but rather with mitigating risk in cost and schedule.

First, I'd like to see AWIPS' project management authority strengthened. Second, AWIPS systems engineering can be strengthened, especially with regard to developing and tracking a project-wide integrated schedule. Third, AWIPS software development management can be improved by focusing responsibility.

Now, at a briefing of the NRC committee two weeks ago, it was indicated that significant attention has been paid to these areas.

I've not had time to review what has gone on, nor to talk to the individuals involved.

The AWIPS project has been the subject of reviews by many oversight organizations. Each report generated requires that AWIPS resources be expended in some sort of response. It is important that recommendations of these agencies be effective and tied to the real world.

Let me address one example. The recent GAO report suggested that major groupings of AWIPS requirements, 450 of them, be justified by analysis, referring back to the mission of the National Weather Service, to avoid gold-plating.

I'm not a meteorologist, but in six years of being involved with AWIPS, I recall no evidence of gold-plating, no one saying that there was gold-plating, or indicating things that were not necessary. Justifying 450 groupings against the mission doesn't make sense to me. I checked back with JPL, and looked at the standards we used in systems engineering. There's nothing that requires a tie-back to the mission, other than at the top level of the project.

I called Jeff Raikes, who is the Senior Vice President of Microsoft. He is the father of the Microsoft office. I explained this to him, and I asked him directly if in developing Windows 95, did they justify all the major requirements against Microsoft's corporate goals? He said, and I quote, "That would be ridiculous, and you can quote me."

[Laughter.]

Mr. ZYGIELBAUM. The GAO made a well-intentioned suggestion, but it does not fit modern practice.

Where do we go from here? I've stated AWIPS is crucial. It has a good technical foundation, and its management has significantly improved.

AWIPS is at a crucial juncture. Based on the technical foundation of AWIPS, the appropriateness of its hardware, the demonstrated capabilities of the prototype software, and the improvements in project management, I recommend proceeding with KDP-4 as soon as possible. The risk in terms of being able to field a usable system is minimal.

Let me state just as a citizen. It's obvious, weather is of intimate significance to every American, personally and professionally. It affects all of us. Significant weather can of course endanger our lives and property. I conjecture that the NWS's products are directly or indirectly accessed by more Americans than any other government service. It's an indicator of what the government can do for the citizens of the United States, and AWIPS has the potential to enable significant improvements in the quality of service and therefore the quality of life of Americans.

The cost of AWIPS and the risk entailed in its development are small compared to its potential benefits. The time for AWIPS is now. Let's get on with it.

Thank you.

[The prepared statement of Mr. Zygielbaum follows:]

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Testimony of Arthur I. Zygielbaum

Submitted to the House Science Committee

Subcommittee on Energy and Environment

February 29, 1996

I. Background

I am honored to have been invited to testify about my perceptions concerning the National Weather Service Modernization. My interest in the Weather Service stretches from childhood weather observing through my days as an active instrument-rated private pilot and into the role I played as a member of the National Research Council's National Weather Service Modernization Committee.

I am testifying as a private citizen. My comments must not to be construed to reflect any views of my employer, the California Institute of Technology Jet Propulsion Laboratory (JPL), a NASA Center, nor, except as otherwise indicated, opinions and conclusions held by the National Research Council or any of its committees or panels.

I am an engineer by training. During my nearly 28 years at JPL, I have developed computer hardware and software supporting space science experiments and spacecraft navigation. As a manager, I headed JPL's Science Information Systems Office, was Deputy Manager of the Information Systems Division, and spent several years working on NASA teams developing recommendations for software standards and methodologies for the agency. In 1989 I

represented NASA at the National Research Council's Workshop on Complex Software Systems. During the past few years I have taken on special assignments in the JPL Director's Office helping the Laboratory reengineer its administrative structures.

In 1990 I was appointed to the National Research Council's National Weather Service Modernization Committee. I chaired the Advanced Weather Interactive Processing System (AWIPS) Panel during my six year appointment and thus have had an extensive opportunity to study the technical and management aspects of the program both within NOAA and, to a lesser extent, within PRC. Also, I recently took part in an Independent Review Team focused upon AWIPS application software development.

II. Bottom Line

The positions that I will develop during this testimony are 1) AWIPS is a significant and necessary part of the Weather Service Modernization, 2) the AWIPS development process, while severely troubled in the past, has made significant improvements, 3) a recent report from General Accounting Office is not in conformance with modern software engineering practice and 4) the need for AWIPS is real and immediate. Although I will make specific suggestions on improving the project, let me emphasize that I have no doubt as to the ultimate success of AWIPS. Existent development processes and management organizations will result in deploying a useable system that will positively and significantly impact products and processes in the Weather Service. The issues I will raise have bearing only on the two risk areas of cost and schedule.

III. "Real World" Meteorology

In performing his or her duties, today's meteorologist must deal with a plethora of different work stations, computers, and data formats. Ancient, marginal, and unreliable workstations and computers such as the Automation of Field Operations and Services (AFOS) system are juxtaposed with modern, ad-hoc workstations and PC-class computers.[1]

In developing a forecast, the meteorologist typically visits six different data sources including 1) PC-based Automated Local Evaluation in Real Time (ALERT) system, 2) NEXRAD Radar Workstation -- Principal User Processor (PUP), 3) PC-based Regional and Mesoscale Meteorological Advanced Meteorological Satellite Demonstration and Interpretation System (RAMSDIS)[2], 4) Surface observations through AFOS, 5) National Centers for Environmental Prediction (NCEP) data models on AFOS, and 6) weather fax (Pacific surface observations and southern hemisphere surface map). After integrating this information, a forecast, warning, or watch is prepared using a PC and transferred to AFOS for dissemination. The forecast is also transferred from AFOS to the ALERT system where automatic updating of words denoting highs or lows and the time tags are performed. This is then passed back to AFOS and thence back to the PC for the next cycle to begin.

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[1] The information in this section was obtained during a "surprise" visit to the Los Angeles/Oxnard Weather Service Forecast Office on February 23, 1996. Meteorologist-in-Charge Todd Morris and his staff were most helpful in bringing to life the practices and systems I had read about. It is interesting to note that AFOS failed during my visit. Mr. Morris informs me that it is not unusual to have several AFOS "crashes" during a work shift.

[2] While RAMSDIS is a good improvement over the earlier facsimile-based system, it cannot display the highest resolution GOES 8 and 9 images. Per electronic mail from Mark Czerwinski, MIT Lincoln Laboratory, February 27,1996.

The complexity of the process encompasses the multiple data sources, the multiple machines involved in generating products, and the need to recover from frequent failures of AFOS itself. Add to this the pressure brought on during an extreme weather event. City and county emergency managers, other government officials, and the press inundate the staff of a forecast office with telephone calls during such times. Each has a legitimate and vital need for information but each adds another burden to the staff.

A recent report by the Department of Commerce Inspector General[3], suggests that the 20 year-old technology embodied in AFOS can continue to serve the NWS. I respectfully disagree. Despite past upgrades, AFOS is unreliable, and has significant limitations. AFOS cannot accommodate the increased data resolution available from National Centers for Environmental Prediction models, cannot display satellite or radar images critical to forecasting, and cannot support overlaying of multiple graphic data types. It is my conjecture that the real cost of AFOS is in the cost of operating personnel and the lost opportunity cost resulting from being unable to access information that could lead to better forecasts and warnings. The National Weather Service Modernization Committee of the National Research Council concurs, ". . . AFOS units at 256 field sites are deteriorating and approaching the end of their useful life. Parts are no longer in production, and test equipment is no longer available for these 1970 vintage computers and displays. Outages can be expected to increase, affecting the quality of warnings and forecasts."[4]

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[3] U.S. Department of Commerce Office of Inspector General, "National Oceanic and Atmospheric Administration, Unrealistic Schedule and High-Risk Decisions Continue to Jeopardize AWIPS Success," Inspection Report No. OSE-7355, February 1996.

[4] National Research Council Committee on National Weather Service Modernization, "Toward a New National Weather Service -- Second Report," National Academy Press, Washington, DC, March 1992.

The current state of the system drives needed staffing levels to ensure that mistakes are not made, that significant data are not overlooked, and to provide redundancy during system failures and extreme weather emergencies.

IV. The Need for the Advanced Weather Interactive Processing System (AWIPS)

AWIPS represents an important departure from the old way of doing business. Composed of computers, software, and communications equipment and networks, AWIPS is, indeed, the integrating element of the modernization. There seems no dispute as to the need for AWIPS. The first report of the NRC's National Weather Service Modernization Committee states, "The Committee is favorably impressed with the prototypes of AWIPS and the capabilities that are afforded to meteorologists and hydrologists in producing warnings and forecasts. . . . without this system, Weather Forecast Offices will be unable to use the new observational technology in an effective manner or to reduce staff through restructuring while increasing service effectiveness."[5] The Inspector General's report referenced earlier states, ". . . AWIPS is the key integrating element of NWS's $4 billion modernization program and is essential to achieving weather service operational improvements and resultant cost savings."[6]

The specific benefits of AWIPS are 1) an improved communications network, 2) the ability to integrate, overlay, and animate graphic and textual information from many sources on one screen at one time, and 3) the capability to automatically generate forecast text. By simplifying the data

[5] National Research Council Committee on National Weather Service Modernization, "Toward a New National Weather Service -- A First Report," National Academy Press, Washington, DC, March 1991.
[6] See footnote 2.

assimilation process, AWIPS will dramatically improve the forecast process efficiency and effectiveness. By automating the text generation process and the mechanics of gathering information, AWIPS will allow meteorologists and hydrologists to do what they do best: meteorology and hydrology.

V. A Tarnished Past

There can be no doubt that AWIPS' past has been tarnished by management, contracting, and personnel problems. PRC was found to be in default just three months after the AWIPS development contract was awarded in December, 1992. This was, in my opinion, an indication of a very poorly structured process on both sides. The "war" that existed among the Systems Procurement Office, National Weather Service, and PRC prevented significant AWIPS progress for an intolerable period.

Things have in the opinion of many, including me, improved dramatically. The new Systems Acquisition Office and the NWS are working together nicely and are establishing a correct and supportive relationship with the contractor. A strong indicator of this is the fact that I and many of my colleagues involved in oversight of the AWIPS program now feel that those involved in oversight can concentrate on technical issues rather than management. The management problems of the past consumed so much of our time and were so pervasive that we could not in good conscience focus on technical issues.

VI. A Bright Future with a Few Challenges

The development of AWIPS is not a "shot in the dark". It is based upon significant risk reduction activities. The AWIPS Pathfinder, while representing a small amount of AWIPS functionality, is in use at three NWS sites. The WFO/Advanced will be used operationally at the Denver and Norman Weather Service Forecast Offices. WFO/Advanced represents most of the functionality of a "full-up" AWIPS at a WFO (it does not include the communications networks, the hydrology functions used at a River Forecast Center, nor the specialized software for the National Centers for Environmental Prediction).[7]

The practitioners, engineers and meteorologists, who programmed the Pathfinder and the WFO/Advanced are resources available for the development of AWIPS. The code they developed can at least serve as templates for "production code" to be developed by NWS and PRC. In some cases the code will transfer directly.

Using the JPL-developed "Software Costing Tool" (SCT) I made an independent assessment of the effort required to develop AWIPS software. SCT accommodates uncertainty through the use of probabilistic modeling. The estimates shown me by the Systems Acquisition Office (SAO) and NWS seem realistic.

[7] Telephone conversation with Dr. Douglas H. Sargeant, National Weather Service Director, Office of Systems Development, February 26, 1996.

AWIPS is a known entity. The algorithms for the major applications running on AWIPS are well understood and actually in use.

The hardware chosen for AWIPS represents the latest workstation technology available from Hewlett Packard. The basic architecture is such that future growth in requirements can be accommodated by adding processors to the basic computer. The communications network interconnecting the elements of AWIPS is similarly expandable by adding additional processing circuit boards.

The software development process has moved from the so-called "big bang" model to the incremental development model now being used in industry. The big bang model consists of identifying all major requirements, reviewing and scrubbing those requirements and proceeding with implementation. The new approach is to "build-a-little" and "test-a-little". This latter method allows design decisions to be tested early, accommodates the fact that not all requirements may be well understood at first, and is much more resilient to changes in requirements as knowledge is gained.

Concern has been expressed by some within NOAA and within the Inspector General's office that this approach cannot be well controlled and could lead to increasing cost. My experience indicates the opposite. Barry H. Boehm, now at the University of Southern California Center for Software Engineering is a well respected researcher in software processes. He is the "father" of the Constructive Cost Model (COCOMO) software costing model. Dr. Boehm supplied me with

a copy of a new paper[8] that will be published in July 1996. In that paper, he writes about the "big bang" approach. He says: "...the ideal of a complete consistent software requirements specification . . . [has] . . . the following problems:

- A prototype is worth a 100,000 words. Written requirements specifications trying to describe the look and feel of a user interface were nowhere near as effective as a user interface prototype.
- Gold plating. Fixed requirements specifications in advance of design tended to encourage software gold-plating. Users asked about their requirements would frequently reason, 'I don't know if I'll need this feature or not, but I might as well specify it just in case.'
- Inflexible point-solutions. Fixed requirements specifications tended to produce point solutions optimized around the original problem statement. These solutions were frequently difficult to modify or to scale up to increased workload levels."

The new incremental approach will help scrub requirements down to the most necessary set.

From the basis of hardware, software, and development process, AWIPS is in my opinion moving in the right direction.

VII. Continuing Challenges

AWIPS has been scrutinized by two Independent Review Teams. The first Independent Review Team was under the leadership of Dr. Herb Kottler of MIT's Lincoln Laboratory[9]. The second

[8] Boehm, Barry H., "Anchoring the Software Process," to be published in IEEE Software, July 1996.
[9] Kottler, Herb, "AWIPS Independent Review Final Report," MIT Lincoln Laboratory, June 29, 1994.

was staffed by Mr. Tom Giammo (retired), Dorthy Perkins (Goddard Space Flight Center) and this witness[10]. Each team identified several common themes. These are areas needing a response from NOAA.

- Project Management. Despite the fact that NWS, SAO, and PRC are now functioning well together, a project as complex as AWIPS requires a single project manager.

  The Kottler IRT stated, "The responsibility for the AWIPS development should be integrated under a single AWIPS development manager in the NWS."[11] The second IRT concurred, "The AWIPS program ought to be driven from a unified development perspective, responsive to a single point that is accountable for balancing the various technical risk/benefit tradeoffs that continually arise in management of this integrated systems development effort."[12]

  In particular, both IRTs indicated that the project manager must have the authority, responsibility, and accountability to 1) set, control, and follow a project schedule, 2) direct the decomposition of the project into manageable elements, 3) select or approve key personnel, 4) identify and control risk and contingency (time, funds, or functionality), and 5) be the final authority for required process and product priority decisions. The project manager must develop and use an integrated project management system.

[10] Giammo, T., A.I. Zygielbaum, D. Perkins, "AWIPS Applications Development Review Study Team Report," to be released by Department of Commerce, March, 1996.
[11] Kottler, ibid.
[12] Giammo, et. al., ibid.

- System Engineering. There is a need for a hierarchical systems engineering organization encompassing NWS, SAO, and PRC. Both IRTs recommended the establishment of a systems engineer office in the NWS. The second IRT suggested, "An overall systems engineer in the Program Manager's office should be responsible for decomposition of the project into technical sub-elements, maintenance of the schedule, identification of an tracking dependencies, and setting development priorities."[13]

- Software Development Management. The second IRT also recommended that a software development manager be identified for AWIPS. This individual would be responsible for policy decisions with respect to the level of formalism, standards, documentation, etc., applied to software developed for AWIPS.

NOAA has responded well to most of the Kottler IRT recommendations. The second IRT report was only recently delivered to NOAA. The response is pending. However, the three areas above remain a concern to me.

VIII. Other Perceived Impediments

The General Accounting Office has suggested that NOAA has "gold plated" AWIPS and that each of the nearly 450 groups of high level requirements should be specifically and individually tied to NWS Mission Goals.[14] While I am not a meteorologist, in my six years as part of the

[13] Giammo, et. al., ibid
[14] General Accounting Office, draft report "Weather Forecasting, Weather Service Has Not Fully Justified All Weather Processing System Capabilities," GAO/AIMD-96-29, January 1996.

NWSMC, I recall no evidence that AWIPS was being implemented with more than required capability. In accord with Dr. Boehm's suggestion, the new incremental approach should help avoid "gold plating."

I know of no common practice that would require tying detailed levels of system or project requirements back to a corporate or agency goal. Certainly the major system or project itself and its highest level description must be tied to the mission of the company or agency. But the amount of analysis that would be required to specifically tie 450 groupings of requirements to mission goals, while well intentioned, seems a waste of effort.

To verify my view, with the help of Mr. John Carroway[15] of JPL, I reviewed JPL system engineering documents that specify traceability of requirements. No tie back to JPL's mission goals are required below the level of a project itself.

I also contacted Jeff Raikes[16], Senior Vice President for North American Operations of Microsoft. Mr. Raikes is the progenitor of Microsoft Office. I asked him if Microsoft's management required that all of Windows '95 major requirements be tied to Microsoft's corporate goals. He indicated a definite "no." In fact he said, "It would be ridiculous and you can quote me." Mr. Raikes further indicated that in many cases, lower level "requirements" were not tied to higher level requirements if the former were discovered as part of the development process and lead to improvements of function or new features.

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[15] Telephone conversation between John Carroway and the author, February 26, 1996.
[16] Telephone conversation between Jeff Raikes and the author, February 26, 1996.

IX. Where from here?

Once again, it is my opinion and that of my colleagues that AWIPS will successfully field a necessary and useable system even if no changes were made in process or organization. Our concern is risk in terms of schedule and cost.

To mitigate that risk, we suggest following the three earlier recommendations of strengthening project management, implementing a hierarchical systems engineering organization, and installing a software process manager. Further I suggest appointing a standing independent review team to periodically assess the status of AWIPS. This team would need to spend significantly more time in review than is possible through the NRC's NWSMC.

I strongly urge that Key Decision Point 4 (KDP4) be performed as soon as possible. Given my knowledge of the state of AWIPS hardware and software, with respect to the pathfinder activities, and acknowledging the talented people involved at NWS and SAO, I believe there is little risk in going ahead with the deployment decision. The hardware and software has been tested and demonstrated. There is sufficient resiliency to accommodate requirement growth. The need for AWIPS is real and immediate.

X. A Last Thought

Weather is of intimate significance to every American. From planning a Sunday picnic through deciding the clothes to wear today, weather affects us personally. From planting schedules through pouring concrete, weather affects us professionally. Because of the significant weather events all too common in the United States, weather can affect the very security of our lives and property.

I conjecture that the National Weather Services' products are directly or indirectly accessed by more Americans then any other government service. The ability of the NWS to do its job is clear evidence of our government's ability to serve its citizens. AWIPS will replace aging, unreliable systems. It will allow meteorologists to do what they do best: meteorology. AWIPS has the potential to enable significant improvements in the quality of services provided to citizens, business, and government agencies.

The cost of AWIPS and the risk entailed in its development are small compared to the potential benefits. The time for AWIPS is now. NOAA needs to focus on accelerating a successful deployment.

Let's get on with it. AWIPS can improve the quality of life for Americans. I am confident that AWIPS will also mitigate the loss of life from severe weather.

Thank you for the opportunity to testify.

XXXXXXXXXXXX

Mr. ROHRABACHER. Thank you very much.
Mr. Brock.

STATEMENT OF MR. JACK L. BROCK, JR., DIRECTOR, INFORMATION RESOURCES MANAGEMENT/RESOURCES COMMUNITY, AND ECONOMIC DEVELOPMENT, UNITED STATES GENERAL ACCOUNTING OFFICE

Mr. BROCK. Thank you, Mr. Chairman.

I would like to remind Mr. Zygielbaum that Windows 95 was delivered considerably late and considerably over cost. That may not be the best example.

I saw the display over there. That stuff blows me away. It's incredible.

When I was 10 years old, eight years old, somewhere in that time frame, I had a Heath Kit weather station that I built, gave my parents half-hourly weather reports for two weeks until one evening the weather stuff mysteriously disappeared from the roof, and my father claimed it was wind blowing it down. I've always suspected my father took it down to end the forecasts.

I had a rather high risk investment there. I didn't realize it at the time.

Mr. ROHRABACHER. Excuse me, Mr. Brock.

What we'll do, we'll continue with Mr. Brock's testimony. And you have about five minutes to complete your testimony. At that time we will break, and go for our vote, and reconvene immediately thereafter.

Mr. BROCK. All the panelists, I think, agree that AWIPS is good capability. It's stuff that's needed. We're not disputing at all the necessity of having AWIPS-like capability to really have a major impact on human safety and on economic well-being.

Our concern is the investment. And both Mr. Roemer and Mr. Davis talked about investment. There's a half-billion dollar investment that they're making here. Mr. Davis referred to the Defense Authorization Act and the Procurement Reform provisions.

Within that Act, there is also something called the Information Technology Management Reform Act, which requires OMB and the agencies to apply new, stringent requirements on system expenditures.

They used to be referred to as expenditures, not as investments. As an investment, you want a return on your dollar. Our concern is not with what AWIPS is trying to do. Our concern is with AWIPS as an investment.

Is that investment being adequately protected? Are they doing the right thing? Are they doing it the right way?

I have four quick points I'd like to make, and I believe I can get those in in the five minutes.

First of all, I would agree with Mr. Zygielbaum that they've done a lot to improve the program. A lot of the early management problems that were present have been eased. They've also done an incredible job of involving the weather forecasting community into determining the requirements and the needed capabilities of the system.

We haven't looked at many system development efforts that have done a better job. However, again, I want to get back to this invest-

ment theme. We think they can do more to protect their investments to make sure it's the right investment, and to mitigate the risks that we believe that could be associated with that investment.

Let me just make these points very briefly. First, while they've done a commendable job in incorporating the view of the forecasting community in developing AWIPS capabilities, they have not demonstrated how those specific capabilities contribute to better forecasts or more efficient operations. They've linked it back to things that forecasters say they want, but not to how it's going to improve forecasts.

Failure to do so means the project runs the risk of spending more than necessary. This in turn will increase costs, as well as place unnecessary stress on the system. We've done best practice work over a number of companies that manage information technology to the best. These people all do this type of software capability matching. This is not unusual in the industry.

Secondly, NWS broke the project into smaller increments. That's leading edge practice in software development. Don't go with the grand design. It's difficult to manage. Break it up into smaller, more manageable units. NWS did that. They deserve some credit for doing that. It's a good thing.

However, the strategy has to be implemented appropriately to work. NWS has adopted a strategy of overlapping these increments. We don't believe that they have full assurance that each increment is stable before they begin to develop and implement the next increment.

As a result, we believe that this instability, if created, could follow throughout the entire range of ills. Again, we think that places some risk on the system.

Lastly, NWS has done some things that we believe have really gone a long ways towards improving the software development processes. This includes preparing a development plan. This was in response to an earlier recommendation by us. However, they're not following good practice by establishing an independent software assurance program.

A good program would provide independent—I want to stress that word "independent"—assurance that software development processes and products meet prescribed standards and deficiencies in the process or product, and that these deficiencies are brought to management attention.

Our work in other areas shows that, again, among leading agencies, among leading corporations, this is in fact standard management practice.

Finally, we have some concern over the cost of AWIPS. The last reported cost that we have is $525 million. This is an estimate that I believe has remained stable since December '94. We believe that this estimate omits certain costs, and appears to be understated.

We have some specific recommendations, Mr. Chairman. Briefly, we believe that the ongoing NWS requirements reviews be broadened to link the capabilities back to the mission improvements. We would like NWS to assure that each incremental build is stable before moving on to the next one.

We would like NWS to establish an independent software quality assurance program. And lastly, we would like NWS to provide an independent assessment of the cost to develop and deploy AWIPS.

That concludes my summary remarks, Mr. Chairman.

[The prepared statement of Mr. Brock follows:]

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Testimony

Before the Subcommittee on Energy and the Environment, Committee on Science, House of Representatives

For Release on Delivery
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WEATHER FORECASTING

New Processing System Faces Uncertainties and Risks

Statement of Jack L. Brock, Jr.
Director, Information Resources Management/Resources, Community, and Economic Development
Accounting and Information Management Division

Mr. Chairman and Members of the Subcommittee:

Thank you for the opportunity to testify on the National Weather Service's (NWS) Advanced Weather Interactive Processing System (AWIPS)—the "linchpin" of NWS' $4.5 billion modernization program. The weather service modernization entails building and putting into place vastly more capable weather observing systems, such as Doppler radars, that will feed a network of sophisticated AWIPS workstations. This AWIPS network, in turn, is to use the observations in combination with national weather modeling results to aid forecasters in making and communicating localized weather predictions. NWS estimates that AWIPS will cost $525 million to fully deploy by 1999.

Mr. Chairman, today we are the bearers of both good and bad news, some of which we pointed out last February during testimony before this Subcommittee. The good news is that NWS has done a stellar job of involving its forecaster community in defining what AWIPS should be. Heeding the advice of a 1994 independent review team, NWS has also reorganized the program to address fundamental management impediments to establishing an acceptable system design and moving the program forward. Additionally, NWS has acted on some of our recent recommendations to strengthen its in-house software development capability.

The bad news is that NWS runs the risk of wasting money on AWIPS capabilities that may not be needed because it has yet to link all planned capabilities to promised mission improvements, such as cheaper operations and better forecasts. Additionally, NWS' ability to meet its AWIPS commitments is being jeopardized by a risky development approach that (1) prematurely begins developing one software increment before the previous increment is stabilized, (2) complicates government versus contractor accountability for inevitable system integration and performance problems, and (3) omits a vital development process known as software quality assurance. Also, NWS expectations for staffing reductions from the modernization continue to shrink.

AWIPS: A Brief Description

AWIPS is to serve as both a weather decision support system and communication system. More specifically, AWIPS is to support forecasters in graphically integrating and analyzing the volumes of weather observations and products that form the basis for decisions on each day's forecasts and warnings. It is also to provide the national communications

infrastructure for NWS field offices and national centers, connecting them not only to each other but also linking them to NWS' diverse customer base. Through AWIPS, NWS expects to tap a reservoir of data from its new observing systems that the aging processing and communication system currently in place, known as AFOS, cannot.[1]

AWIPS' progress to date has been uneven. Despite early successes in effectively involving forecasters in AWIPS requirements analysis and definition activities and demonstrating the technical feasibility of AWIPS functions, AWIPS made little progress during 1993 and 1994 because of an impasse with the development contractor over the AWIPS design and shortcomings in NWS' program management. Acting on the recommendations of an independent review team, NWS was able to move the program forward in 1995 by restructuring the program and renegotiating the development phase of the AWIPS contract. Renegotiation of the deployment phase of the contract is ongoing.

Under the restructuring, NWS assumed responsibility for developing all AWIPS hydrology and meteorology application software. Also, development of the system was divided into a series of seven increments of increasing functional capability. Thus far, the first increment has been installed at three sites to gain experience in developing, testing, deploying, and operating a very limited version of AWIPS. Development of the second increment is underway.

NWS' current project cost estimate for AWIPS, which was first reported in December 1994 and according to NWS is still valid, is $525 million or roughly $58 million more than its previous official estimate done in October 1992. The current schedule calls for AWIPS deployment to be completed in 1999 or one year later than NWS projected in 1992.

How Much AWIPS Capability Is Enough?

Since its inception in the early 1980s, NWS has justified the modernization, and its component systems, on the grounds that it will produce significant "service-to-the-public" improvements—namely, better forecasts at less cost. To facilitate attaining these goals, NWS has specified that AWIPS must provide about 450 high-order capabilities, such as the ability to execute certain models or display data in certain formats and colors. All told, these high-order capabilities are composed of about 22,000 separate system requirements.

[1]AFOS stands for Automation of Field Operations and Services.

In defining AWIPS' capabilities, NWS effectively solicited and incorporated the views of the forecaster community: In this regard, it performed multiple requirements analyses and reviews and it effectively employed system prototyping to ensure that forecaster perspectives were heard and understood.

However, the true measure of AWIPS' value is not that forecasters like it, but rather that it contributes significantly to improving NWS' mission performance. In studying the practices of leading public and private sector organizations, we found that successful organizations' system investments are based on explicit and quantifiable mission improvements. By doing so, these organizations know that investing in system capabilities are justified and will make a difference in mission outcomes, such as service delivery or product quality.[2]

Unfortunately, NWS has not demonstrated that the package of capabilities it envisions for AWIPS will enable it to make better forecasts, operate fewer field offices, and reduce staffing levels, leaving the question wide open as to whether AWIPS, as envisioned, is the "right thing." In our view, unless NWS takes advantage of ongoing and planned AWIPS prototyping to validate that proposed capabilities produce measurable mission improvements, it runs the risk of wasting taxpayer money.

AWIPS Software Development Risks Remain

Our recent work on the NWS modernization has identified several AWIPS development risks, particularly with regard to the system's software. Despite the fact that NWS has moved to mitigate some of these risks, others remain that require careful management attention and action. The risks are (1) a development approach that is predicated on overlapping software builds,[3] (2) lines of accountability between the government and the contractor for the system's development that are unclear, and (3) extensive software development that is occurring without a software quality assurance program. Each is discussed below.

- In its recent restructuring of the AWIPS program, NWS responded to the recommendation of a 1994 independent review team and broke the system's development into increments, thus employing a widely accepted risk reduction strategy of "build-a-little, test-a-little." Generally speaking,

[2]Executive Guide: Improving Mission Performance Through Strategic Information Management and Technology (GAO/AIMD-94-115, May 1994).

[3]Software builds are a series of software increments, each with increasing capabilities, that add to or build upon the capabilities of the preceding increment.

incremental development breaks a large, monolithic system development effort into several smaller, more manageable development pieces, thereby permitting earlier warning of significant system development problems, and avoiding expending the huge sums of money associated with developing a complete system before more basic capabilities are successfully developed.

The key to effective incremental development, however, is to ensure that each software increment or build is stabilized (i.e., free of material defects) before adding new capabilities (i.e., software components) to it during succeeding builds. Without build stabilization, new software problems are introduced on top of already existing, unresolved problems, greatly increasing the time and money needed to produce mature software. In February 1995, we testified that NWS was not providing itself the opportunity for AWIPS build stabilization because it had chosen to overlap its software builds as a means of schedule compression to meet arbitrary deployment dates.[4] Specifically, NWS plans to enhance and extend AWIPS software components (i.e., capabilities) before these more basic capabilities, upon which the enhancements and extensions will rely, are fully developed and tested. Without a mature baseline to begin each build, existing software defects are likely to be compounded, causing the time and money needed to complete AWIPS to grow.

NWS officials agree that overlapping AWIPS' software builds is a risk. However, they stated that this risk will be mitigated by completely testing one build before moving on to the next. Our analysis of the AWIPS build schedule does not support these statements, revealing that software builds are scheduled to begin before the previous build has been stabilized (i.e., fully tested and debugged).

While we appreciate and share NWS' desire to field AWIPS capabilities as soon as possible, thereby allowing it to take full advantage of its new observing systems' data sets, we believe that overlapping AWIPS' software builds introduces an element of risk that could ultimately slow the system's completion rather than accelerate it, not to mention raise its price tag.

- In January 1993, we reported on several AWIPS risks confronting NWS, including unclear roles and responsibilities between the government and

[4] "Weather Service Modernization: Despite Progress, Significant Problems and Risks Remain (GAO/T-AIMD-95-87, Feb. 21, 1995).

the contractor.[5] Again last year, prior to AWIPS' restructuring, we testified that this risk remained.[6] Under AWIPS' recent restructuring and the associated renegotiated development contract, the government has maintained a large software development responsibility, writing all the hydrology and meteorology applications, while the contractor delivers the AWIPS' hardware, systems software, and communications networks and integrates these with the applications. The government's exposure to risk, however, still remains because it is uncertain whether the government or the contractor will bear responsibility for resolving any software defects discovered during system integration that are not readily attributable to either party.

- In December 1994, we reported that NWS' in-house software development processes were not adequate for anything more than the AWIPS prototyping activities that NWS planned for itself at that time.[7] As just mentioned, however, NWS has since assumed responsibility for developing over one-half of AWIPS' 1.5 million lines of code, thus making its need for mature internal software development process capabilities absolutely vital.

While NWS has reported taking a number of steps to strengthen its software development processes, such as establishing a software development plan, we are aware of at least one serious process weakness that remains. Namely, NWS has not established a software quality assurance program for AWIPS. In a nutshell, software quality assurance exists to address the management axiom of "what is not tracked is not done." Such a program independently (1) monitors whether the software and the processes used to develop it fully satisfy established standards and procedures and (2) ensures that any deficiencies in the software product, process, or their associated standards are swiftly brought to management's attention. In our view, the absence of a software quality assurance program for AWIPS exposes the project to unacceptable cost, schedule, and performance risk.

[5]Weather Forecasting: Important Issues on Automated Weather Processing System Need Resolution (GAO/IMTEC-93-12BR, Jan. 6, 1993).

[6]Weather Service Modernization: Despite Progress, Significant Problems and Risks Remain (GAO/T-AIMD-95-87, Feb. 21, 1995).

[7]Weather Forecasting: Improvements Needed in Laboratory Software Development Processes (GAO/AIMD-95-24, Dec. 14, 1994).

Originally Promised Staffing Reductions Will Not Materialize

Among the mission benefits to be derived from the NWS modernization was a 21 percent reduction in its then current staffing levels—a drop from 5100 to 4,028. However, in September 1995, we reported that the 4,028 target staffing level had grown to 4,678—a decrease in projected staff savings of 650 or 61 percent.[8] NWS attributed the reduction in expected staff savings to underestimating the number of staff needed to operate and maintain the new systems as well as unexpected, external direction to add field offices and perform specialized forecasting activities. As a result of the Secretary of Commerce's October 1995 decision for NWS to add one more field office and three NEXRAD sites, expected staffing savings will decrease even more, perhaps by as much as 60, according to NWS officials. Such a staffing change would increase NWS' target staffing level to 4,738, which is 710 more than the original target levels.

In conclusion, the inadequacies of AFOS and the potential utility of incorporating new observing systems' data sets into forecast models and analyses argue strongly for an AWIPS-like system to support NWS decision-making and communications needs. However, because NWS has not linked AWIPS capabilities to explicit, measurable improvements in mission performance, we do not know whether AWIPS as currently defined with all its capabilities is a wise investment. Furthermore, because of continuing software development risks, it is uncertain that NWS will deliver AWIPS as promised.

Mr. Chairman, this concludes my statement. We will be happy to respond to any questions you or Members of the Subcommittee might have at this time.

[8]Weather Service Modernization Staffing (GAO/AIMD-96-239R, Sept. 26, 1996).

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Mr. ROHRABACHER. Thank you very much, Mr. Brock.

This committee will be in recess for 15 minutes.

[Recess.]

Mr. ROHRABACHER. This hearing of the subcommittee will come to order. We have with us today the Chairman of the full Science Committee who has a subject area that he would like to discuss, that is extraneous to the focus of the hearing today. But as a courtesy to the Chairman, we're going to provide him some time now to follow up on some questions that he wanted to make sure were posed on the record.

Mr. Chairman?

The CHAIRMAN. I thank you for that, Mr. Rohrabacher.

These questions are a little bit off the subject of the specifics of today's hearing. But they are a matter of great concern to the committee.

Dr. Baker, I'd just appreciate it if I could have you respond to a couple of things that have come up as a result of some correspondence your office has been having with mine.

As you know, I requested some information with regard to the report that appeared in the Los Angeles Times about some travel situations at the Department of Commerce. I have received some preliminary information back. It's my understanding that it will be about a month before we're able to get all the information together.

Is that your understanding as well?

Mr. BAKER. Yes.

The CHAIRMAN. First, in response to my question about cost overruns in 1994, the response that we got is that the numbers in the IG report were wrong, and that you only exceeded your travel budget by 50 percent, instead of 84 percent. That still seems to be a rather large overrun.

Is that something which is being addressed at this point by the Agency?

Mr. BAKER. Chairman Walker, thanks for raising that point and giving us an opportunity to comment on that.

In those years—and that was just at the time that I arrived—we did not do a travel budget which was a careful estimate of what would be spent in the year to come.

But in fact, the travel estimate that was used in the President's budget was in fact basically an accounting number based on previous year's expenditures. If that were done correctly, it should have reflected the travel that would be taking place for programmatic needs.

It's also my understanding that a number of the numbers which were used by the Inspector General's report included some items such as moving expenses, which we would normally not include in travel; included reimbursable activities which were also not part of that; and then these additional program activities.

In the past two years, we have spent more on travel than the previous estimates, primarily because our travel is largely done by field office people going to training, and moving back and forth in the weather service. This is the largest part of our activities, and that's what drives it.

As we try to move towards the modernization and associated restructuring, we have had more travel costs in our field offices than we had had in previous years.

The CHAIRMAN. We must admit that we have a little bit of confusion on that, because our understanding is that the IG's $34.8 million figure had already backed out the change of duty costs, and that it was a figure that was exclusive of that.

Now, you're saying that the problem with the figure is that it includes those kinds of costs. That doesn't seem to be reflected in the documents that we have here.

Mr. BAKER. Let us give you the specifics on that. I don't have those numbers right here. But we'll try to give you an exact accounting of that, so that we can make sure that we're working from the same base.

The CHAIRMAN. That's obviously what we're trying to do is, we're trying to get an exact accounting here. I want to be fair in this. But in all honesty, we've got some very troubling information that's out there on the public record at the present time. And I think we've been exceedingly patient at this point in terms of trying to get the information that we think we require on this. And it's been awful slow in coming.

Let me just ask one other thing in that same vein.

The IG was evidently sent a memorandum from NOAA on January 31st, 1995, indicating that the total travel expenses were actually $37.125 million. Now, that's a figure that is very high, in our view. It's a figure that this committee was never informed about. And it would even seem to exceed the $34.8 million figure that the IG had referenced in his report.

Can you give us some explanation for that?

Mr. BAKER. I'm sorry, Mr. Chairman. I can't give you information on that. We'll have to provide it for the record.

The CHAIRMAN. We've also been taking from your answer that the unforeseen travel expenses that were overruns were because of the National Weather Service Modernization Program. Most of the extra travel was related to the modernization program.

Can I get some explanation as to how that could be? The modernization has been underway for some time. It seems like I've worked on it ever since I've been on the Science Committee. I'm a little surprised that all of a sudden, we're having significant cost overruns that we're now told are related to the modernization program.

Mr. BAKER. Let me ask Joe Friday to give you an answer on that, Mr. Chairman.

Dr. Friday. Mr. Chairman, the modernization cost of transition, the actual movement of people from place to place to the new offices as the new radars came in, is all accounted for under what we refer to in the budget as the MARDI line, the Modernization Associated Demonstration and Implementation Program. That has been funded each and every year.

I think the difficulty that incurred is, those costs have been included in the cost of transition, but were not identified explicitly as a travel cost for the purposes of the travel record. I think that's the difficulty, and I think that's the issue that needs to be clarified as they come forward.

But it shows in 1993 and 1994 and 1995 that the bulk of the permanent change of stations have occurred in the modernization of the weather service.

The CHAIRMAN. So all those transition costs—travel costs, or aren't they travel costs?

Dr. Friday. They are travel costs. They have been budgeted.

The CHAIRMAN. They are not among the expenses that the IG backed out of his report when he talked about change of duty costs?

Dr. Friday. I'm not certain.

The CHAIRMAN. We're going to need an explanation on that.

The other thing we've noticed in the documentation we've received so far is that NOAA is owed over $100,000, and as nearly as we can tell, almost $213,000 in travel expenses paid to non-Department of Commerce employees.

Who would those people be?

Mr. BAKER. I don't have a list of those, Mr. Chairman.

The CHAIRMAN. I have a list of them here. It's a good part of this book.

Mr. BAKER. I know it has been identified. There are, for example—Congressional staff will do some travel with us, for example.

The CHAIRMAN. In some cases here, what we're finding is that some of these people have been dunned up to four times for expenses that they owe the government, that range in some cases, $2,500, as high as $4,000, and so on.

What are we doing beyond continuing to send them dun notices to recover the money that has been advanced?

Mr. BAKER. We have a process whereby we do try to recover money. We can get back to you specifically on what we're doing about these cases. We'll do that for you.

The CHAIRMAN. It will also be helpful, I will say to you, to find out just exactly who these people are. So far, what we've been given is names. The names are not very helpful in trying to figure out who it is that's been getting advances of taxpayers' money and then not paying it back.

So it would be helpful, as you go through this process, to give us a better idea about who these folks really are. We certainly would want to know what's being done to recover the money.

And then just one final area. There has been an indication that there had been a good deal of credit card abuse at NOAA. What are we doing to make certain that that has stopped?

Mr. BAKER. As you know, Mr. Chairman, we have a government travel charge card. Current government regulations state that frequent travelers, that is people who travel more than two or three times a year, should apply for the government charge card.

We operate in that system as all federal agencies do. There have been some abuses. There is with all such systems. We follow every one of these cases down to the final end. And if it's serious abuse, that person will be terminated.

But I can tell you that I personally see all of the reports on these, and we do take action. I don't believe that NOAA has a record of problems with charge cards that are any different from any other federal agency. But of course, this is something that we're very concerned that this is done right.

The CHAIRMAN. One other response that we got in writing from you says that a review of the travel of history of the Secretary of Commerce and the DOC security personnel shows that no NOAA funds were used to pay travel costs for these individuals or the Secretary.

Mr. BAKER. Yes, sir. That's correct.

The CHAIRMAN. So as we proceed forward on this, we are going to find that absolutely no—zero—NOAA funds supported the Secretary in his travel; is that right?

Mr. BAKER. That's our understanding. We've done a careful look at the records.

The CHAIRMAN. And none of the people who accompanied the Secretary on these travels were paid for out of NOAA funds other than NOAA employees?

Mr. BAKER. That's correct. There have been some NOAA people who have accompanied the Secretary on some trips. NOAA has paid for that, and it's been a NOAA function.

The CHAIRMAN. So even when the Secretary has traveled on behalf of NOAA, no NOAA funds have been expended for his travel?

Mr. BAKER. Yes, sir. That's correct.

The CHAIRMAN. That's helpful. I thank you very much for your responses.

Mr. ROHRABACHER. Thank you, Mr. Chairman.

Dr. Baker, I'm going to give you the opportunity now to ask any question of Mr. DeGeorge or Mr. Brock that comes to mind after hearing their testimony, because there might be some clarifications that you would like to make.

I can't give you that right, to question Chairman Walker, however.

[Laughter.]

Mr. ROHRABACHER. But I can afford you that privilege, now that we've had some people who have been able to take a few pot shots at the job you've been doing. If you would like to try to ask for some clarifications or set the record straight on some of those points, please feel free right now.

Mr. BAKER. Thank you, Mr. Chairman.

I must say that Chairman Walker and I have interacted over the years on these issues, and I think we see eye to eye on most of the topics that we are talking about.

We're very sorry to hear that he is going to be departing the Congress. He's been a big supporter of science and technology and weather service modernization, and we do appreciate that help.

Chairman Rohrabacher, I think we're all working from the same page on AWIPS. And when I came into NOAA in May of 1993, I sat down with Frank DeGeorge at his suggestion, and we had a long talk about the problems of big systems and how NOAA was handling this.

The problems that NOAA had had in the past, the issues that we were going to face for the future, and how we were going to make sure that NEXRAD, and GOES, and the polar satellites, and AWIPS system, and the Automated Surface Observing System, were all going to come together in a way that really made sense; that is, cost effective, staying within caps, and reducing the risk.

He and I have had regular conversations, and I think there is nothing in the discussion that he has presented that he and I have not had some talk about.

We don't agree with the Inspector General on all of the points. But if you remember, his first statement was, "We're really arguing only over a small part of the process, but a very important part." That is, how do you put together the interactive processing system to really make it work?

We believe that the changes that we have made in NOAA—and they are substantial, if you look at the NOAA of 10 years ago. We have a very mature acquisition process. We have a weather service that works very closely with the acquisition process. We think this is a system that is working.

There are tensions always between an acquisition process and a programs process, and one has to make these work. We believe, however, that that is a system that is working. But as I say, we work very closely with the Inspector General's office. And as they identify problems, we try to move to solve those problems.

He supports incremental build. We support the incremental build. He thinks we're not ready to get it out. We think we have enough expertise and knowledge to make this work, and that we can get it out.

I think the demonstration you see over there, both the weather service Forecast Advanced, and the Pathfinder system, is a good example.

On staffing is probably where we have our biggest disagreement. We think we are moving in a sensible way to actually make modernization happen. He would like to see us reduce staffing more rapidly. We think we're doing it as rapidly as we can. But we are concerned with staffing issues. And we think it's very important.

One of the points I think to make clear is that we have a lot of people in the Washington area, but not all these people are simply headquarters administrative support. We have a very large functionality here with what was the National Meteorological Center, now the National Centers for Environmental Prediction, where it all comes together.

This is where we actually do the big models, and the forecasts. So one would not like to arbitrarily reduce the staffing.

But I think we have a close interaction without a lot of disagreement about the big issues. As far as the GAO report is concerned, once again, I think there were a lot of positive statements made by Mr. Brock. We have done a lot to improve the system. We have involved the user community. He said that we've done better than most there. And I think I would agree with that.

He made a couple of very important points about software development that we are also concerned about. Are the increments stable as we move ahead? And do we have independent assurance for software development? I think the answer is yes in that case. And I think it's really a question of having the GAO come in and look carefully at exactly what the Systems Acquisitions Office has done in terms of software development.

We have independent contractors looking at the software. We will review that ourselves. We have an independent assurance. We don't need yet another group to come in and look at it. I think

there, the GAO needs to come in and look very carefully at the details of what we're doing, because I think we're following that good industry practice.

In a nutshell, I think we're all concerned. Big software development is always a major action for an agency. And I think between NOAA, the Inspector General, the GAO, and our own expertise, I think we're making progress here.

Mr. ROHRABACHER. Thank you, Dr. Baker.

I think all witnesses that are basically here to be under scrutiny for the job they've done—I think all the witnesses in your situation deserve a chance to have rebuttal time. And I'm very happy that you used that.

I'd like to now recognize Mr. Davis, who will have to be leaving in a few moments for a luncheon speech, for a couple of questions. Then I will turn to Mr. Roemer. Then we will continue the dialogue later on.

Mr. DAVIS. Let me just ask a couple of general questions. A lot of this, the discussion, I know we've wrestled with this on the Procurement Reform Bill, the big bang theory versus the incremental approach.

There seems to be the consensus here that the incremental approach is the correct way of doing that. I seem to have heard that from everybody's testimony; is that correct? If a dispute really arises that we have disparate increments being developed, and maybe not to be completed, and then being linked with other elements that are moving ahead without the other areas being solidified——

I don't know if I'm explaining it that well. But NASA will often use 20 different components that were assembled independently of each other, and they're linked at the end. But it sounds like some of the concern, Mr. Brock, coming from you is that we have disparate components that are not completed before your moving in with other areas.

Do you feel that maybe they aren't going to be talking to each other without the software approved and tested in one component before you move ahead with the others? Is that it?

Mr. BROCK. Yes, sir. That's correct. We believe that if you have overlapping builds, even though it's being done incrementally, that you increase the risk of instability going from one increment to the other.

I'm not saying that the instability will always be there. But you're certainly increasing the risk that that can occur.

Mr. DAVIS. But you are able to accelerate the time for completion if you do that, and if you're successful. Is that the trade-off?

Mr. BROCK. If you're successful, you can accelerate the time. But if you're not successful, that time that you gain will be more than lost at the end when you have software that doesn't work properly.

Mr. DAVIS. Let me ask Mr. DeGeorge to respond. Then I'll ask Dr. Baker and Dr. Zygielbaum, who have looked at this and come to different conclusions. I want to understand it a little better.

Mr. DEGEORGE. I think I'd define the problem in a slightly different way, Mr. Davis. The builds that we're going through overlap, which in effect means that we're doing a lot of the testing and de-

velopment in parallel. And they are interrelated. You do, therefore, increase the risk.

There's a commensurate possibility that everything will go well. It's our judgment that in effect, if you can avoid that, that you would be better off. And that's essentially part of the debate that we have.

The second element is more important in my mind. I don't think we ought to assume at this point, at this late stage in the game, any more risk than we have to. So we're really arguing that, in effect, if you put out and release this system now, and by well over $100 million, by my estimation, of equipment and hardware, that in effect by the time you finish the development of this process, which may very well be a year to two years from now, there's some chance that that hardware will have to be substantially augmented or replaced.

To the extent that you can restrict that loss by doing this in series rather than in parallel, we would endorse it. Now, that's a professional difference of opinion. We do not feel you need to run that fast.

I think Joe Friday and Jim Baker are right when they say everyone wants it. So do I. The issue is, what's the best way for the Congress to be assured that all the necessary oversight and judgment is being added to that process, so when we have either parallel builds or are producing less before we can release the hardware, that there's some way for your committee to be assured that the minimum risk is being——

Mr. DAVIS. Let me ask if I can, Mr. Zygielbaum, who's really kind of independent in this, coming at this as a third party. You've looked at these kinds of things before I think, and I'm interested in what your conclusion is on that.

Mr. ZYGIELBAUM. I have looked in particular at each of the builds on AWIPS. That's one of the challenges of being on these committees. You get snapshots four times a year.

But as I understand it, the way I would do it, I think the parallel development is probably okay. The concern is absolutely correct. If it's not done well you can get yourself in trouble.

But I believe there are ways to mitigate that. For example, you do have a build going on in parallel. You're starting work on a second build. The critical thing is that, once you begin integrating components of the second build into the first, that the first build is reasonably stable. I think if you don't do that, you are headed for trouble.

I haven't looked specifically, but I suspect these are smart people working on this within NWS and their contractor, I know they're smart enough to be sensitive to that.

Mr. DAVIS. You've also got government workers who are very concerned with this thing failing and falling down. They have more to lose if it fails than anybody else here.

So my guess is that they probably overdo on the side of being safe.

Mr. ZYGIELBAUM. I think that.

And the other thing I'm very impressed with, with the weather service, is that they have the toughest testers in the world. That's

the forecasters, the people at the end who are going to want it done right, and be sure that it is done right.

Mr. DAVIS. Let me just ask Dr. Baker then.

You've heard the complaints. If you could just respond. Once again, you're pretty confident at this point that everybody's talking to each other, and that this is going to go on schedule, and the risk if minimal?

Mr. BAKER. There is no question that there is risk whenever you're trying to make a new system work. And we have, as Frank DeGeorge pointed out, we would like to get the system in place. We have some parallel activities. But at the same time, we're trying to make sure that what we build is stable.

Bill Mehuron is the head of our Systems Acquisitions Office. He's had a lot of experience in building this way. We've had a lot of discussions with NASA about how you put together systems and integrate them.

As you say, in the end, we're the ones who fail if it doesn't work. So we believe that there is a minimal amount of risk, and this is the way to get the system in place, as the quickest possible way with minimum risk.

Mr. DAVIS. The other concern you always have in procurements like this is, who's in charge? And at this point, we're comfortable, who's in charge in making the decisions in terms of, from the federal agency's point of view. When you walk into the room you can tell a contract's—who is in charge, and everybody's working.

But some of the early issues have been resolved at this point, and we are comfortable with who's in charge?

Mr. BAKER. I think we are comfortable with how we are operating our system. As we say, NOAA has changed. We today have a very mature acquisitions process, which we did not have before. That acquisitions process works very closely with the weather service, who is ultimately in charge of making sure that it works, because they're the ones that have to deliver the services.

At the same time, we have to have a relatively independent acquisitions process because that's a separate activity.

But the close interaction between those units, just as we have in the Defense Department, is working very well with the Agency.

Mr. DAVIS. That's all the questions I have.

Mr. ROHRABACHER. Thank you very much, Mr. Davis.

And I guess, Dr. Baker, we will know—I mean, we're going to find out, I hope, Mr. DeGeorge is wrong. But we will know that if he is right—if he is right, we're going to have you right back up here, and all your "sorry's" won't mean any difference, if it means $50 million more to the taxpayers.

I'm glad you're confident and we're listening to you. And I'm glad we're getting Mr. DeGeorge on the record. I'm sure that with his comments on the record, you're going to pay much closer attention to make sure you're right.

With that, I'd like to turn over this to Mr. Roemer to see if he has some questions.

Mr. ROEMER. Thank you, Mr. Chairman.

First of all, just a quick comment on the modernization process. I understand, Dr. Baker, with the furlough and the shutdowns in government a few times, that there have been some delays in

terms of some of the modernization plans with respect to NEXRAD, especially with respect to some of the new NEXRAD.

In Northern Indiana, we would hope you would get right back on track on these proposals, and implement these as soon as possible.

My question, however, relates to what we're talking about today, and that's AWIPS. Let me ask a question.

Mr. ROHRABACHER. Before you do, let me address the alternatives. Do you want five minutes of questioning before we break?

Mr. ROEMER. Yes.

Mr. ROHRABACHER. We will have five minutes worth of questioning from Mr. Roemer. Then we will break for one half-hour and return in one half-hour. That will give everybody a chance to get a sandwich or something.

Mr. ROEMER. Dr. Baker, certainly some of the criticisms coming from Mr. DeGeorge and others have some legitimacy. And hopefully this criticism is constructive and positive and healthy.

You suggested in your opening statement that I'm not sure was part of your prepared comments that you were willing to work with the National Research Council as an independent reviewing of your testing data.

Can you be a little bit more specific in what you might let the National Research Council—what you might let them review in terms of some of Mr. Zygielbaum and Mr. Brock's recommendations to improve and strengthen this program? What they're capable of doing, what they would be helpful in reviewing and analyzing?

Mr. BAKER. Congressman Roemer, thank you.

I had about a paragraph in my written statement, which I added to the oral comments, about this. Let me expand just a little bit on that.

As you know, we have a modernization committee in the National Research Council that has provided us with very good independent advice on modernization. And we turn to them for continual help.

And we've asked them if they would be willing to lead an independent assessment, and this is what they would look at, the methodology, the conduct, and the results of the AWIPS operational testing and evaluation.

That means reviewing the plans, making sure that criteria are met, and monitoring the actual testing to make sure that it really is consistent with the plans, and then reviewing the results.

I have said that we are willing to share those results, report those results back immediately to the Committee, so that we can have feedback on that process. This is something that could be an ongoing activity.

But I think we're very sensitive to that, and we want to be responsive. And we recognize the need for this independent review of the AWIPS operational testing and evaluation.

Mr. ROEMER. You stated more specifically your agreement that the parallel software build concept can work if each software package is stable. I think both Mr. Zygielbaum and Mr. Brock have commented on this.

When NOAA submits their data to the NRC this year, do you think that the NRC will be able to make that kind of judgment?

Mr. BAKER. Yes, sir. I hope that they would, because that's an important fact for us.

Mr. ROEMER. Would you, Mr. Brock, Mr. Zygielbaum, and Mr. DeGeorge, agree with that assessment, that NRC is capable of providing that kind of analysis?

Mr. BROCK. I would certainly agree that NRC has the resources that are capable of doing that. It would of course ultimately depend upon who was on the review panel.

Mr. ZYGIELBAUM. I'd agree. There's a process that can be put into place, and I understand we'll be hearing that in detail very soon.

Mr. ROEMER. Mr. DeGeorge?

Mr. DEGEORGE. I'd rather wait to comment on the characterization of the process. Who's the participants? I really cannot comment at this point, Mr. Roemer.

Mr. ROEMER. Thank you.

Dr. Baker, do you envision any kind of additional cost or overrun to this program?

Mr. BAKER. Congressman Roemer, we believe that the number we have—and let me just check to make sure I know what it is at the moment. Cost to complete is $525 million. Excuse me, cost at completion. There's a difference there. Let's make sure that's correct.

We believe that the program could operate at a cost cap. Whether it would be exactly that number or slightly more, we would have to sit down and work it out. But we think we know enough about this program at the time, and what we can deliver, that we could operate at a given cost cap.

That being said, I think once one sets a cap on a program, it's also important to make sure that the funding increments come at the time that they're proposed. Otherwise, it costs the program more.

But we think we know enough about the technology development and what we can do that we can operate within a cost cap which would be very close to that number.

Mr. ROEMER. So you could live within a statutory cap of $525 million? And that would leave you with enough in reserve, as long as your caveat is that you get sufficient regular scheduled funding that would not add to a delay or cost overrun?

Mr. BAKER. I think the key factor in having a cost cap is having an agreement that the funding comes in a regular scheduled amount so we know what we're going to get. If we don't do that, it's very hard to work a cap, because delays drive the cost up.

But the answer to that question is yes.

Mr. ROEMER. Thank you, Dr. Baker.

Thank you, Mr. Chairman.

Mr. ROHRABACHER. We will return for the questions of our other members of the committee. This subcommittee is in recess until 12:45.

[Recess.]

Mr. ROHRABACHER. The committee is called back into order.

Dr. Baker, just let me throw a few questions in your direction, then we'll get back to a little bit of the back and forth on some of the points that have been made in earlier testimony.

I understand that, when all is said and done, what we're going to have after this modernization program is a reduction in the number of field offices by more than half; that we will need fewer than half of the field offices that are currently in place. Is that right?

Mr. BAKER. Yes, sir. That's correct.

Mr. ROHRABACHER. Now, my staff points out to me that we're only expecting to have a drop in staffing by seven percent. So we're cutting the number of field offices in half. But what's projected is only a seven percent reduction in staff.

Maybe you could give me a better understanding of why that discrepancy seems to exist.

Mr. BAKER. Let me get Joe Friday to answer that, because there's technical aspects as to how the numbers are worked.

Dr. Friday. The reduction down to the 4,768 as the final number, as contrasted to the 5,100 when we started many years ago, is the reduction in staff. But the difference between the number of field offices is explained in the fact that the vast majority of the field offices that we have in the weather service at the present time have on the order of five to seven people.

The new offices, each one with its next generation weather radar, with access to the digital satellite data and the like, has a staff of somewhere between 20 and 25.

So what we have done is, we have improved the capability around the country for providing weather service, more accurate forecasts, more complete services, but at a far fewer number of sites. So there is a total reduction in staff, a total savings in that capacity, and a substantial reduction in the overhead costs of the buildings, facilities, and the like, itself.

Mr. ROHRABACHER. Mr. Brock, could you characterize what you consider to be the staffing trend since 1989, and in the future?

Mr. BROCK. The only numbers we have, Mr. Chairman, are the numbers that have been provided by NWS. As I understand from my project manager, Mr. Hite, we had difficulty obtaining some of those numbers. If you don't mind, I'd like him to elaborate on that a little bit.

Mr. ROHRABACHER. Hite?

Mr. HITE. Randy Hite.

Mr. ROHRABACHER. Spell that name for us.

Mr. HITE. The last name is H-i-t-e.

We were able to obtain staffing levels in terms of full-time equivalents—those are FTEs—for fiscal year '89, and then again, for fiscal year '95.

For fiscal year '89, they were 5,100. And in fiscal year '95, they had risen to 5,511. The numbers in between that for that five-year period were not available. We requested those. And the way it turns out is that that information had been destroyed in some type of fire. So those numbers were not available.

Mr. ROHRABACHER. All right.

Mr. Brock, are there any red flags that you think that we should be looking at in terms of staffing?

Mr. BROCK. You know, we have no evidence of any red flags. We were concerned that the estimates changed over time. As I said, we don't have any information, I think that's relevant as far as to be

able to evaluate as to those reasons whether or not they're valid or not. We did not do that sort of review.

Mr. ROHRABACHER. Can you elaborate a little bit on the differences between yourself and the weather service on the cost estimates of the AWIPS?

Mr. BROCK. I was frankly kind of surprised that Mr. Baker agreed to a 525 cap. The last estimate we had was 525 as well. That was the same 525 estimate that we got in December of '94. And since that time, several things have happened that we believe would cause the estimate to go up.

For example, these are things that are known. There was a renegotiated contract that was $10 million more. They haven't renegotiated the development or the deployment portion of the contract yet. But that's estimated to be $9 to $11 million more.

Some things that aren't known yet is that they've apparently used up their $50 million or so they had built in for contingency. That is no longer available.

We believe that there's obviously some room for code-growth. This is pretty common. This doesn't necessarily have anything to do with mismanagement. But code-growth is very common, and I don't think there's a contingency for that.

In addition, we were told that the deployment phase has been extended one year until 1999, and there was no cost for that included in the estimate.

So we think the 525 could actually be understated.

Mr. ROHRABACHER. Is code-growth included in that estimate?

Mr. BROCK. Originally the estimates had contingencies. Part of that contingency could have taken care of code-growth. As we understand it, according to the National Weather Service, the contingency funds have been used up, and we don't believe that if any code-growth occurs, which we think is highly likely, that they wouldn't have the funds available.

Mr. ROHRABACHER. Dr. Baker, would you like to respond to that?

Mr. BAKER. Let me respond in a general sense. When I said I would agree to a cap, I said that we might have to change that a little bit. The fact is, we are going to renegotiate the deployment phase.

But the overall point is that I believe that we all have to learn to live within caps. We don't think there are major technological breakthroughs to make this program work. And if we can get agreement on both sides, that we could get a rate of funding that would allow us to finish up in a reasonable time, we think we could make this work.

The other are some things that we don't know all the details yet. On the other hand, we recognize we've got to live within caps, just like everybody else does. So these are constraints on the program.

Mr. ROHRABACHER. We all have to live under caps. And then the caps imply that we do have a contingency fund, usually. Are your contingency funds used up?

Mr. BAKER. Let me ask Bill Mehuron who runs our Systems Acquisition Office to address that specific contingency.

Mr. MEHURON. My name is Bill Mehuron, M-e-h-u-r-o-n.

We do independent government cost estimates for the program. We just completed one this month. It's very slightly above the 525, but not a significant amount.

That reflects our best judgment as to what the deployment phase would cost, as well as any possible growth in the software development costs. But we don't think they are significant at this point in time in either area.

There are some reserves that we include, just because things happen, and we try to keep that at a very modest level. And we can provide that to you.

Mr. ROHRABACHER. Thank you very much. Do you want to say something more on that, or has that pretty much covered that?

Mr. BROCK. I'm sorry. Were you referring to the costs, sir? No, I think we've covered that.

Mr. ROHRABACHER. Thank you.

I just want to get back to some of the things that Mr. DeGeorge was saying. It sounds to me like, Mr. DeGeorge, you're basically saying that we have not reached a stage yet in our development, even of our software, that we should be moving forward to the next step. And you're afraid that this is going to cost us a lot in the long run.

Where do you think the threshold is before you actually get to the point where you're moving forward?

Mr. DEGEORGE. I guess I'd address it this way, Mr. Chairman. I would first confirm that I think there's no chance of meeting the 525 number. I think it will be substantially higher than that, as we've said in our testimony.

The issue on where you get to the point of getting enough confidence in the software——

Mr. ROHRABACHER. If you'd like to expand on that.

Mr. DEGEORGE. On the cost estimates?

Mr. ROHRABACHER. You can go right ahead on that.

Mr. DEGEORGE. I buy just about everything Jack has to say. The $50 million contingency was used up in the last negotiation. We've not yet negotiated the hardware portion of the last revision.

I just kind of find it hard to suggest that it's going to go down, and it probably will go up.

We have—programming is taking longer at absolute terms than it was planned to. When you have a staff of people that are being employed, I doubt if PRCs will intercept such a gap. Those people will be paid and be charged to this cost plus fixed P contract.

They probably have 100 or 200 people on—I'm not totally familiar—and extend that time of year, which I think is minimum, you'd get some sense of why I think their present estimates are probably low.

Offsetting that, conceptually I think hardware, if defrayed beyond what I would call mod testing, the first 16 units of releases, it may well go down. In other words, if you buy it two years from now, with the way technology is going, I think conceptually it may be cheaper.

I think the manpower and the development costs are going to be more expensive. If you make a total release now, I think the ultimate hardware cost is going to be more expensive. If you hold it off, I think you may defray some of those expenses.

Mr. ROHRABACHER. And about the threshold question that I had for you about software, you're basically saying the software is not developed to the point that we can buy the hardware, but justifies buying the hardware. I think that's your basic point; is that correct?

Mr. DEGEORGE. Just about. But I guess I would add a little more emphasis. I think you should deploy when you have been satisfied that the software will work adequately, that's number one. And I and my staff do not feel that we're at that point yet, with such a small percentage of the software developed.

I know that the weather service has pointed out that some of the fundamental designs have been tested, and do work on the communications and hydrology side. Maybe, maybe not. I'm not yet convinced.

I think the debate is really over an issue that you don't really have to do it at this moment. You may need some marginal equipment to do the storage, given the inherent problem with underestimating the coding and what all the problems will be in the actual line by line coding.

If you don't have to do it now, I suggest we delay it. I'm not absolutely sure how long you delay it. I'm not talking about years. If we're 20, 30, 50 percent by August, maybe we're talking about a year.

Mr. ROHRABACHER. Mr. Zygielbaum, do you see any problem here? We just heard that we don't have the software developed to the point that we need it in order to really reasonably assure ourselves that we're making a good deal on the hardware.

Mr. ZYGIELBAUM. Let me make a couple of comments. I haven't looked in particular exactly at this point in time, at what's developed out at PRC, and what sits there. It is a valid concern to understand where they are.

On the other hand, to my mind, I have a friend who never bought a computer, and the reason is, he knew a year later it was going to be cheaper. That's always true.

Mr. ROHRABACHER. You're looking at the same kind of guy.

[Laughter.]

Mr. ROHRABACHER. I'm still scribbling out, instead of buying that laptop. I'm sure it's going to be $200 cheaper next year. That's why I've been using that yellow pad for five years.

Mr. ZYGIELBAUM. Which is not getting much cheaper.

I believe that you're not going to make any major different decisions on the hardware, even after a delay. This is a good set of hardware. It's modern, it's expandable. I realize you don't want to do it because it leads to cost growth, but if you need to, you could easily expand the equipment much cheaper than starting off with a new suite of hardware later.

So I don't have the worry about deployment.

Now, one of the things that's really nice about the way the weather service has performed their development—it sits over there—it's the prototyping activities. Now, just coding, just writing code, is not the big danger point in software. It's typically in the requirements specification and in the initial design.

Now, the design is in effect done. I realize it will be modified as you get into the nuances, but there it is over there. They've gone through and found a path through the major decisions.

On the specification, if you have to fix something in software, the cost of fixing it goes up exponentially with the maturity of the system. That is, if you find an error early, you can fix it fairly cheaply. If you find an error 60-70 percent through the development, it's much more expensive to fix.

That's why, as an engineer, I would like to see AWIPS out there. I'd like to see the equipment deployed so you can get that early experience, understand what may be incorrect or not quite right in the specification, and get that corrected early.

Mr. ROHRABACHER. I'm going to again give Dr. Baker a minute to close up the hearing today.

Do you have any final thoughts?

Mr. BAKER. Just one point, Chairman Rohrabacher about the hardware issues.

The hardware that we are looking at now is what we call open system. That is, we can add capability relatively easily. We have in fact negotiated into our deployment pricing reductions in hardware costs, because we recognize that this is something that will happen.

What I hope that we can do is to get all the players who are involved with this, the GAO, the Inspector General and so on, to visit at least one of our offices that has these prototype systems in place.

We have an office in Boston that has both the weather forecast and get a sense of how we're working.

We're all working together to get this thing right. I think we know enough about the system and its technology that we can work within a cap. I think that's the right way to operate. And we're prepared to operate with independent review teams, as I have suggested.

So I think our areas of agreement are a lot closer than our areas of disagreement. But one thing is sure. This subject has our full attention. I want you to know that.

[Laughter.]

Mr. ROHRABACHER. And as you are aware now, it has our attention as well.

So I'd like to thank each and every member of the panel. Thank you very much for giving us your time and your expertise and your food for thought.

We're going to keep in mind as we follow this program the testimony that we heard today. And I'm hoping that Dr. Baker is absolutely correct. And I want to be cautious enough to remember what Mr. Brock and Mr. DeGeorge have told us today.

So thank you all very much.

This hearing is adjourned, not recessed.

[Whereupon, at 1:15 p.m., the Subcommittee was adjourned, subject to the call of the Chair.]

[The following material was received for the record:]

THOMAS M. DAVIS
11TH DISTRICT, VIRGINIA

COMMITTEE ON
GOVERNMENT REFORM AND OVERSIGHT
CHAIRMAN,
SUBCOMMITTEE ON THE DISTRICT OF COLUMBIA
SUBCOMMITTEE ON GOVERNMENT MANAGEMENT, INFORMATION AND TECHNOLOGY
SUBCOMMITTEE ON HUMAN RESOURCES AND INTERGOVERNMENTAL RELATIONS

COMMITTEE ON SCIENCE
SUBCOMMITTEE ON ENERGY AND ENVIRONMENT
SUBCOMMITTEE ON SPACE AND AERONAUTICS

Appendix I

Congress of the United States
House of Representatives
Washington, DC 20515–4611

415 CANNON HOUSE OFFICE BUILDING
WASHINGTON, DC 20515
(202) 225-1492

DISTRICT OFFICES
7018 EVERGREEN COURT
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730 ELDEN STREET, SECOND FLOOR
HERNDON, VA 22070
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13554 MINNEVILLE ROAD
WOODBRIDGE, VA 22192
(703) 590-4599

OPENING STATEMENT OF CONGRESSMAN DAVIS
BEFORE THE ENERGY AND ENVIRONMENT SUBCOMMITTEE
ON THE STATUS OF THE NATIONAL WEATHER SERVICE
MODERNIZATION PROGRAM

FEBRUARY 29, 1996

Mr. Chairman, let me commend you for holding this hearing. The National Weather Service Modernization program is of vital importance. As you know Weather Service Modernization touches every American in every part of our country. This program will greatly advance our ability to forecast floods, hurricanes, tornadoes and other weather patterns. I believe we need the system completed as quickly as is responsibly possible

That is the question before us today. How quickly can we complete the system and ensure effective operation? To offer their perspectives, we have as witnesses today, The Commerce Department Inspector General, the GAO, the Jet Propulsion Lab which served a key role an the independent review of the AWIPS component of the modernization effort, and the National Weather Service.

At a time when many of us in Congress are justifyably seeking reduction or elimination of wasteful or inappropriate government functions, the National Weather Service passes every test as a service critical to each and every American citizen. The NWS gives us the reliable weather forecasting that we need and rely upon.

I welcome the views of the GAO and the Inspector General and have read their reports on the Weather Service Modernization. Oversight is critically important, but when it comes from too many directions it serves no purpose except to delay, and turn the development of major system into little more than confused paper debates. This type of action can end up costing the taxpayer tens of millions of dollars. With the Weather Service Modernization., delay means the potential loss of hundreds of millions of dollars that might otherwise be saved if floods, hurricanes and the like could have been forecast sooner. More important than the economic loss is the loss of lives that might have been avoided.

Mr. Chairman, the Defense Authorization Act recently signed by the President includes major procurement reform provisions. I worked on and sponsored those changes with Government Reform and Oversight Committee Chairman Bill Clinger. One of our objectives in that bill was to encourage more communication and cooperation between users and sellers. We specifically encouraged a systems development approach now being used by the NWS to incrementally develop and deploy AWIPS. Prior to this incremental development approach, an elaborate and

costly contract bureaucracy was put between the end user and the provider. Congress has endorsed this approach, which I support, with passage of the procurement reform provisions of the Defense Authorization Act.

AWIPS' launch was a good example of why the old approach to systems development doesn't work. The contract began with an agreement between one company, PRC, Inc. and the National Weather Service. Between those two - and against the wishes of the NWS - was added a contract shop called the Systems Program Office, which inhibited communication between the two parties who should have been constantly talking. Then came direction from different offices, the IG, GAO, GSA, and an independent review team. As such, the program was delayed and price went up.

Today, we seem to be back to the end user and the company, who are now working together and are moving forward. This is the way the system should work. Mr. Chairman, let me close by wishing all involved much success. Our country needs the benefits of their services. Thank you.

Inserts T.1

OPENING STATEMENT
BY
TIM ROEMER

NATIONAL WEATHER SERVICE MODERNIZATION
PROGRAM STATUS

Mr. Chairman, I want to acknowledge the importance of this hearing today on the Weather Service Modernization program. No other program within our jurisdiction will touch as many Americans as personally as the National Weather Service and the modernized forecasting system we are attempting to put in place. In addition, no other program within our jurisdiction will so clearly achieve economic benefits many times in excess of the costs. Once the modernization is completed, segments of the U.S. economy will see benefits of more than $7 billion per year. This is, in every sense of the word, an **investment**.

This compelling justification has led to a widespread bipartisan agreement in Congress to support NOAA throughout this transition process. This agreement has now transcended three Administrations. This is however a two way street and I am certain that NOAA recognizes it obligation to keep the Congress informed and to focus its very best management attention on this program.

Today we will be discussing some of the problems that have been encountered in the AWIPS program and some of the decisions that will need to be made to keep this program on track. AWIPS, as we will hear, will be

the "nerve center" of the future weather forecast office. It will give the local weather office the information and the communications capabilities that will be needed to fulfill the basic mission of the National Weather Service to provide warnings and forecasts for the protection of life and property. Obviously we feel the responsibility as an oversight committee to see that this is done right and done on time.

I hope that today's hearing will give the Committee a better understanding of exactly what needs to be accomplished to make the decision to enter into full production and deployment of the AWIPS system later this year. What are reasonable criteria that we can use to judge whether you have made enough progress to make a prudent decision?

Finally, I hope that we, as a Subcommittee, can resist the temptation to micromanage this program. Clearly it has had its share of troubles and it has had its share of reviews. But, by many accounts, it has also make some notable progress. I believe we can all agree on the ultimate objective of fielding a working system as soon as we can.

Once again, Mr. Chairman, I want to commend you for holding this hearing and I look forward to the testimony today.

SHEILA JACKSON LEE
18TH DISTRICT, TEXAS

COMMITTEES:
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SUBCOMMITTEE ON CRIME
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Congress of the United States
House of Representatives
Washington, DC 20515

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WASHINGTON, DC 20515
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1919 SMITH STREET, SUITE 1180
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HOUSTON, TEXAS 77002
713-655-0050

February 29, 1996

Written Statement Submitted by Congresswoman Jackson Lee for the Subcommittee on Energy and Environment Hearing on the Weather Service Modernization

The forecasting and information services provided by the National Weather Service are services that most Americans, including myself, take for granted. These services provide information and data which many times have made the difference between life and death. The excellent work that the National Weather Service does is all the more impressive considering the antiquated equipment and systems it must contend with.

It can be agreed by all that NOAA's Weather Service Modernization program must be carried forth to bring NOAA's capabilities into the 20th Century. The new system will be light-years ahead of the old one and from what I am told, those that have just the test version of AWIPS would prefer that to AFOS.

There have been three different independent reviews of AWIPS by the Commerce Department's Inspector General, the General Accounting Office and an independent review team. The first two of these have been critical of the AWIPS program, but they addressed different issues and were even contradictory with respect to some fundamental themes. Regardless, however, NOAA believes it has ironed out many of the fundamental difficulties and is just now getting on a path which will allow it to go forward with full production of the hardware. The need for AWIPS has been clearly demonstrated with GAO concurrence and it would be unwise to block continued development of AWIPS until the decision to proceed is made in October.

While we should require that NOAA report to this committee prior to making any decisions regarding the program, the members of this committee should also allow the men and women of NOAA, who have worked long and hard to correct many of the previous cost and management problems to go on with their jobs and allow them to make the full production decision in October. As you know, the Texas gulf coast has seen its share of severe weather and I make this appeal on the behalf of all those people who depend upon NOAA for their livelihoods and lives.

Testimony of

The National Weather Service Employees Organization

by Ramon I. Sierra, President

for the

Subcommittee on Energy and Environment

Committee on Science

U.S. House of Representatives

February 29, 1996

Thank you, Mr. Chairman, for this opportunity to provide testimony on the status of the National Weather Service (NWS) modernization program.

I serve as National President of the National Weather Service Employees Organization (NWSEO), which represents about 5,000 employees of the National Oceanic and Atmospheric Administration. Our organization was chartered in 1976 and is comprised mostly of NWS employees.

Mr. Chairman, we understand that you and the members of your subcommittee are interested in the progress of the NWS modernization, and with the progress of the AWIPS program in particular. It should come as no surprise to you that the NWS meteorologists are even more concerned about the AWIPS problems and the cost increases experienced by this program to date. The Weather Service's current array of computers, comprised of AFOS and several ad hoc desktop personal computers, is indeed cumbersome but workable. However, because of its dependence on this hodgepodge of hardware, the agency will not be in a position to capitalize on its investment by improving services to the degree possible with a fully-functional AWIPS.

In its February 1996 report, the Department of Commerce Inspector General takes issue with NOAA's accelerated schedule for AWIPS, characterizing it as unrealistic and risky, and predicting delayed schedules and increased costs as a result of this overly-optimistic schedule. NWS meteorologists, whose geographic area of responsibility and workload have increased significantly under the agency's restructuring, have grown weary of waiting for the technology that was supposed to have the capability of simplifying operations. Additional setbacks in the AWIPS program will prove demoralizing for the NWS work-force, a work-force that is concerned about PRC's ability to deliver, in a timely fashion, a computer system which is capable, stable and mature enough to support weather service operations. In the present fiscally austere environment, NWS employees would not look favorably upon additional work-force

reductions to fund increased AWIPS development costs, especially those caused by continued poor program management.

In order to base the procurement decision to proceed with full deployment of AWIPS on substantial development of this system, we recommend that the decision to commit AWIPS to full production, known as KDP-4, be delayed for six months. Since the NWS anticipates that AWIPS will have the capability to replace AFOS and support weather service operations about a year after the scheduled KDP-4 (October 1996), the postponement of KDP-4 will allow the NWS and the AWIPS contractor sufficient time to demonstrate their lessons learned from the development of the Pathfinder, a pre-AWIPS computer system now operating at three NWS sites. During this period, the agency should continue upgrading the existing Pathfinder units and deploying more of these units in order to allow more forecasters to take advantage of the new data sets generated by the new technology and improve service to the public sooner. This approach may require additional funding, but may be funds well spent if the IG's latest assessment of the program prove to be true.

Furthermore, we agree with the IG's recommendation that operational test and evaluation of AWIPS at KDP-4 should be done by independent, reputable experts. The importance of AWIPS to achieving weather service operational improvements and resultant cost savings and to guard against a degradation of weather services are powerful reasons to demand a thorough, unbiased test and evaluation process of this computer system.

The NWSEO agrees with the Assistant Administrator for Weather Services that some form of stream-lined certification process should be retained to assure the public that no degradation of weather services results from the modernization and restructuring of the NWS. Additionally, we recommend that the Weather Coordination Officer positions provided by P.L. 102-567 be retained for no more than two years after station closure at selected spin-down offices, as previously agreed to by the NWS and the NWSEO, in order to ensure that services to citizens are served adequately by the more distant Weather Forecast Offices.

With respect to the IG's recommendation that NOAA should seek opportunities to accelerate office closures, we believe this is already happening. In fact, the Modernization Transition Committee (MTC), authorized by P.L. 102-567, will be reviewing 34 proposed consolidation certifications on April 24, 1996. Additionally, the MTC agreed on December 15, 1995 to forego consultations on proposed, non-controversial closing, consolidation, relocation, and automation certifications prior to the public comment period. This decision will serve to streamline the certification process and save government funds.

While spin-down offices may not be closing in significant numbers yet, many of these offices are now un-staffed as functions are transferred to spin-up offices along with permanent staff. With the transfer of the human augmentation of ASOS function from NWS to FAA or contract personnel, the reassignment of permanent staff members from spin-down to spin-up offices will accelerate in FY '96, creating additional closure candidates. The southern region of the NWS alone had twelve such un-staffed spin-down offices as of October 1995. With the prohibition in P.L. 102-567 against office closures prior to January 1, 1996 now moot, closure

certifications should not pose much of a problem with most spin-down offices.

Mr. Chairman, in correspondence addressed to you in February of last year, we advised against proceeding with deployment of additional Automated Surface Observing Systems (ASOS), as we had been doing for several years. With less than a month before the end of the current winter season, the public, and especially the aviation community, have been made aware of the limitations and deficiencies of this observing system, either through firsthand experience or media reports. Users have noticed that the sensors fail to report freezing precipitation. The ASOS continues to report rain instead of sleet. The problems with ASOS sensors are so acute, that the FAA has decided in the interest of aviation safety to provide human augmentation for ASOS at major airports.

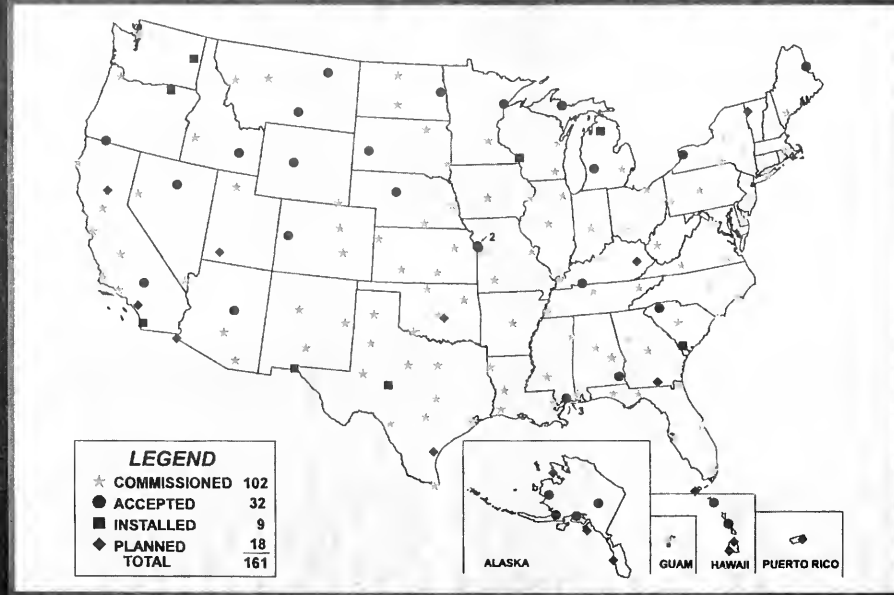
Congress has come to recognize the seriousness of the problem. In a response dated October 25, 1995, to one of his constituents, Rep. Hefley (R-CO) characterized ASOS as a system with serious shortcomings. The Congressman added, "...the program has become the consummate 'porker' -- more costly and less effective, not only than its stated goals, but than the outmoded system it replaced." The deficiencies and limitations of the ASOS make the need for better satellite imagery and more accurate radar data in support of the NWS forecast and warning functions even more urgent. This argues for the immediate deployment of Pathfinder or other pre-AWIPS units into field forecast offices, while the agency develops an AWIPS with full capabilities that can replace AFOS. We trust that Congress will keep GAO looking closely at how the agency addresses the ASOS problems that have been identified.

Mr. Chairman, in a matter related to our mission of providing the best possible weather service to the American public, we would like to bring to the subcommittee's attention a change in aviation weather support provided by the NWS to the FAA Air Traffic Control System Command Center in Herndon, VA. The FAA has decided to terminate its contract, effective March 28, 1996, for aviation weather support by NWS meteorologists co-located at the Command Center. This center is responsible for air traffic control across the entire national air space. The FAA intends to charge its traffic managers with the tasks of monitoring, analyzing and relaying weather reports, forecasts and warnings from off-site NWS facilities, as well as the job of coordinating with airline meteorology departments, in support of Command Center air traffic control operations. We feel that removing highly-skilled NWS meteorologists from the process is not worth the savings and creates an unacceptable risk to aviation traffic across the nation. Furthermore, it is contrary to a recent report by a National Research Council's Committee on National Aviation Weather Services, which recommended that the FAA "should provide the leadership, establish the priorities, and ensure the funding needed to improve weather services for aviation users and to strengthen related research."

I appreciate the opportunity to convey NWSEO's concerns on these important issues and thank you for your commitment to ensuring implementation of a safe and efficient modernization program.

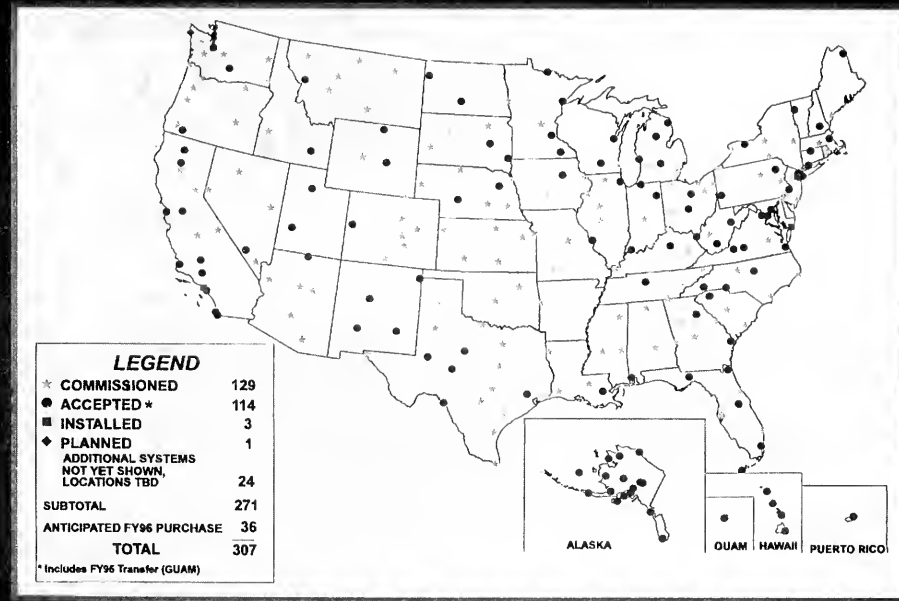
Tri-Agency NEXRAD Status

as of 1/31/96



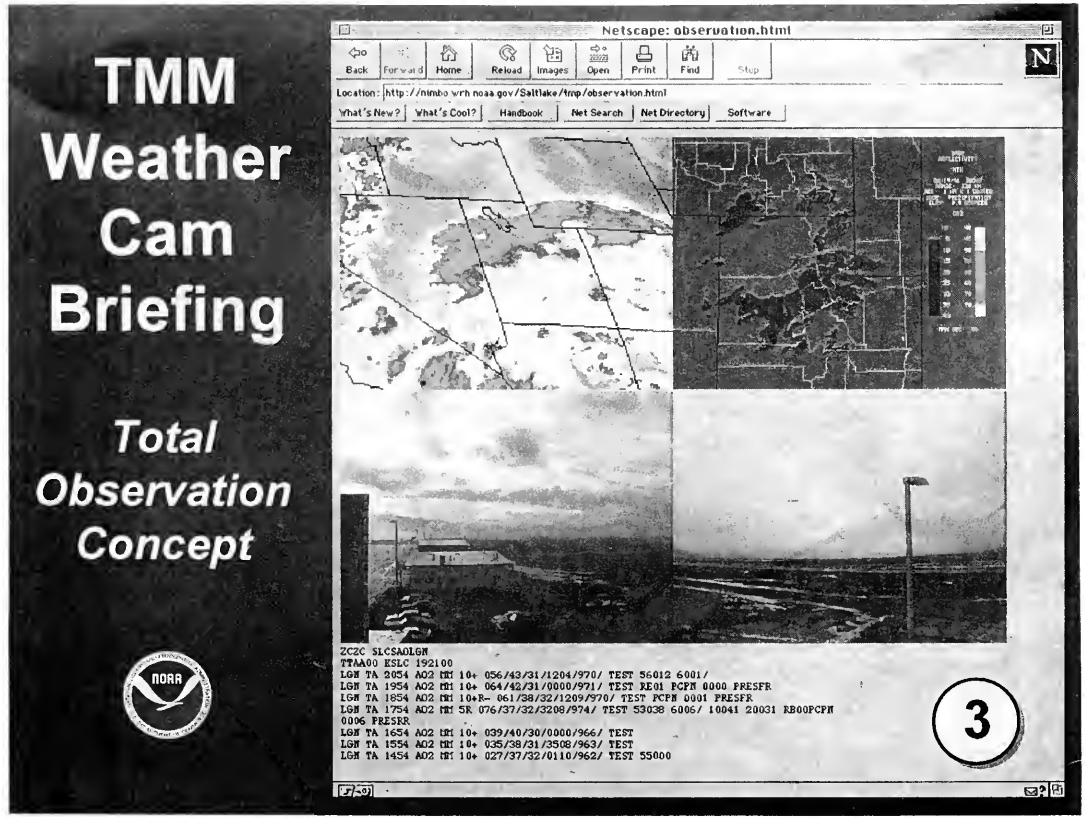
NWS ASOS Status

as of 1/31/96



TMM Weather Cam Briefing

Total Observation Concept



ASOS Representativeness, All Conditions
Commissioned Sites - Feb 15 - Aug 15
NOAA
Probability ASOS is "REPRESENTATIVE"
1
0.98
0.96
0.94
0.92
0.9
SKY-HGT
DEW
WX-TYPE
VSBY
SKY-AMT
SKY-CIG
TEMP
WSPD
WDIR
ALSTG
WGST
Weather Element

UNITED STATES DEPARTMENT OF COMMERCE
The Inspector General
Washington D C 20230

Appendix II

FEB 5 1996

MEMORANDUM FOR Dr. D. James Baker
Under Secretary for Oceans and Atmosphere

FROM: Frank DeGeorge

SUBJECT: *Unrealistic Schedule and High-Risk Decisions Continue to Jeopardize AWIPS Success* (Report No. OSE-7355)

This memorandum transmits the final report on our latest inspection of AWIPS. We conducted this inspection to assess issues of concern associated with AWIPS restructuring and contract renegotiations, evaluate the suitability of plans for the production decision, and determine the feasibility of closing field offices before AWIPS becomes available

We believe that NOAA's accelerated AWIPS schedule is unrealistic and cannot be achieved. Although NOAA maintains that AWIPS must be deployed quickly because of the fragile condition of AFOS, we found that AFOS, augmented by other meteorological systems, can continue to support NWS operations at least to the year 2000. In addition, NOAA intends to ask the Secretary of Commerce to make the AWIPS production commitment and deploy the system nationwide before it has conclusively demonstrated that AWIPS can replace AFOS. Finally, we found that NOAA can expedite field office closures.

Although NOAA agreed to expedite field office closures, it generally disagreed with our conclusions, contending that the AWIPS schedule is realistic and that it is effectively managing the risks of deploying AWIPS without the capability to replace AFOS. However, AWIPS development activities are already falling behind the new schedule established during the most recent round of restructuring. At this point, the only way NOAA can meet the production decision milestone would be to reduce the capabilities that will be implemented. This strategy would make this milestone even less meaningful and more risky.

We continue to believe that NOAA's approach to AWIPS will perpetuate the persistent cost growth, schedule overruns, and technical performance problems. It is imperative that NOAA establish a realistic schedule that permits a sound management approach and plan for a production decision that allows AFOS to be replaced. We reaffirm our conclusions and recommendations.

We appreciate the cooperation of NOAA staff during this inspection

Attachment

cc: David J. Barram, Deputy Secretary
Gloria Gutiérrez, Acting Chief Financial Officer and Assistant Secretary for Administration
Alan P. Balutis, Director, Budget, Management and Information
Diana H. Josephson, Deputy Under Secretary for Oceans and Atmosphere
Dr. Elbert W. Friday, Assistant Administrator, National Weather Service
Mary M. Glackin, Acting Systems Modernization Manager, National Weather Service
William O. Mehuron, Director, Systems Acquisition Office
Stuart M. Williams, AWIPS Acquisition Manager

U.S. DEPARTMENT OF COMMERCE
Office of Inspector General

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Unrealistic Schedule and High-Risk Decisions Continue to Jeopardize AWIPS Success

Inspection Report No. OSE-7355 / February 1996

Office of Systems Evaluation

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OFFICE OF INSPECTOR GENERAL
FINAL INSPECTION REPORT
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
UNREALISTIC SCHEDULE AND HIGH-RISK DECISIONS CONTINUE TO JEOPARDIZE AWIPS SUCCESS

EXECUTIVE SUMMARY

The Advanced Weather Interactive Processing System (AWIPS) is being developed to replace the antiquated Automation of Field Operations and Services (AFOS) system, which processes meteorological data and distributes it to National Weather Service field offices and other facilities AWIPS is intended to provide forecasters with modern interactive processing and display capabilities, as well as the capability to acquire data from the advanced observing systems coming on-line At a cost of over $500 million, AWIPS is the key integrating element of NWS's $4 billion modernization program and is essential to achieving weather service operational improvements and resultant cost savings Thus, it is of the highest priority

Despite its importance, AWIPS has been characterized by management instability, sluggish technical progress, substantial cost growth, and protracted schedules In our two previous inspections of AWIPS, we found that NOAA lacked a management approach that was responsive to the issues and that the AWIPS Development Phase was begun prematurely, without a system design. Both inspections disclosed that inordinate self-imposed schedule pressure was a major factor contributing to the problems with AWIPS. Although a system design should have been a prerequisite for entering the Development Phase, more than 2-1/2 years have passed since that phase began, and NOAA has only recently received what it considers to be an acceptable design. Because of the problems with AWIPS, the Development Phase contract could not be performed and was renegotiated A contract modification was signed in August 1995 with a cost increase of $68 million NOAA's difficulties in developing the system design and the need to renegotiate the contract prompted this inspection

The objectives of our inspection were to (1) assess issues of concern associated with AWIPS restructuring and contract renegotiations, (2) evaluate the suitability of plans for the production decision, and (3) determine the feasibility of closing field offices before AWIPS becomes available Our major conclusions are as follows:

- **NOAA's accelerated schedule for AWIPS is unrealistic and risky.** NOAA intends to commit AWIPS to full production by October 1996, but this schedule is arbitrary, unrealistic, and cannot be achieved NOAA arrived at this schedule by planning to perform design activities simultaneously that should be performed sequentially, compressing the time to complete design activities, removing critical design activities from the development process, and altering key parameters of its scheduling tool to artificially yield a shorter development time frame Experience has shown that under this approach,

accuracy and quality will be compromised in a futile attempt to meet schedule, leading to unnecessary and excessive errors and expensive rework. This schedule, in our opinion, will perpetuate the cost, schedule, and technical performance problems that have characterized AWIPS since the Development Phase began. We believe this phase will substantially overrun its schedule and budget. (See page 3.)

- **AFOS can continue to support NWS operations, making AWIPS acceleration unnecessary.** NWS officials state that AWIPS must be deployed quickly because operations will be harmed by the fragile condition of AFOS, the inability to provide field forecasters with improved meteorological data, and the inability of AFOS to visually integrate and overlay meteorological data. Our analysis of the current operational condition of AFOS and the availability of new data contradicts this view. Since AFOS became operational in 1982, NWS has made numerous enhancements to increase the system's capability, maintainability, and reliability. We found that current NWS operations are being successfully performed using AFOS augmented by other meteorological and sensor systems. In fact, field offices now have access to data that is dramatically better than that available just five years ago. Furthermore, we believe operations can be supported by AFOS at least to the year 2000. Thus, although AWIPS is clearly needed to improve operations and supportability, its development should not be needlessly or recklessly accelerated. (See page 10.)

- **NOAA's plan for the AWIPS production decision adds risk.** According to NOAA's plans, the Secretary of Commerce will be requested to make the decision to commit AWIPS to full production, termed Key Decision Point 4 (KDP-4), in October 1996. Full production may be approved when system performance has been satisfactorily tested under operational conditions. After this decision is made, NOAA will begin to deploy AWIPS to 144 sites nationwide. Until recently, NOAA had planned for the production decision to be made after it had demonstrated that AWIPS could replace AFOS. NOAA now plans for this decision to be made with a lesser capability. Thus, NOAA intends to ask the Secretary to make the production commitment before it has demonstrated that AWIPS can replace AFOS and with substantial software design and implementation remaining. This approach introduces a high risk of cost growth, is unnecessarily disruptive to field operations, and jeopardizes user acceptance. We believe the hydrometeorological capabilities have been reduced because AWIPS is far behind schedule, with minimal progress made since contract award. Therefore, this program is under intense pressure to demonstrate results. NOAA should not seek a commitment from the Secretary for production without conclusively demonstrating that AWIPS will fully support operations in the modernized weather service. (See page 13.)

- **NOAA should seek opportunities to accelerate office closures.** NEXRAD radar coverage permits the functions provided by the field offices slated for closure to be transferred, allowing these offices to be closed. Nonetheless, NWS has made AWIPS availability a condition for office closure, leaving the time frame for closure uncertain and

any cost savings delayed and diminished NWS asserts that field offices cannot be closed without AWIPS because of the limitations of AFOS and because these offices continue to be an integral part of the NWS structure and a vital link to the communities they serve. However, as noted earlier, we found that AFOS, combined with supplementary data and systems already used in the field, can sustain operations without degradation of service In addition, the community functions performed by the field offices to be closed are independent of AWIPS and will eventually be performed at permanent forecasting offices Therefore, NWS should establish policies, procedures, and schedules to expedite transfer of those responsibilities. NWS should identify alternative approaches, such as re-routing local communications circuits, to allow office closure in the absence of AWIPS. Any offices that need to stay open because of unique circumstances should be justified on a case-by-case basis (See page 18)

Our recommendations begin on page 22

NOAA's Comments and OIG Discussion

NOAA generally disagreed with our conclusions and recommendations It contended that the AWIPS development schedule is realistic Moreover, it argued that AWIPS development must be accelerated because new data sets now available cannot be fully used due to the limitations of AFOS and because weather services are currently relying on prototype software packages and makeshift communication systems NOAA also maintained that the KDP-4 milestone is sound, despite the fact that the system at that point will have minimal hydrometeorological capabilities and will not be able to replace AFOS. NOAA contends that it is effectively managing the accompanying risks. NOAA did, however, agree to proceed with office closure as rapidly as possible, although it did not commit to a plan and schedule for doing so, as we recommended.

Although AWIPS development activities are once again falling behind, NOAA's response to our draft report defended the schedule as realistic and achievable In fact, until recently, neither NOAA nor the contractor acknowledged that the October 1996 KDP-4 milestone was in jeopardy or that it was unrealistic, although the major software development milestones were slipping. However, during a formal progress review held on January 17, 1996, the contractor expressed concerns about KDP-4, indicating that it had underestimated the effort required for software development. Clearly, the only way the KDP-4 schedule can be maintained is to reduce the capabilities that will be implemented, making this milestone even less meaningful and more risky Although they strongly disagreed with our recommendation to develop a realistic schedule, NOAA officials recently told us that they are planning to extend the schedule for developing the capabilities that will be implemented after KDP-4, which are needed to allow AWIPS to replace AFOS

Experience to date on AWIPS unequivocally demonstrates that a patently unrealistic schedule, rather than motivating developers to extraordinary performance, will ultimately lead to longer development times and higher costs than a sound, achievable schedule In these lean budget

times, it is imperative that NOAA pursue a responsible course of action on AWIPS, particularly if the current systems are as fragile as NOAA suggests in its response to our report

We have presented a synopsis of NOAA's comments on our conclusions and recommendations in the body of the report, along with our discussion of the response A copy of the complete NOAA response is included in an attachment We reaffirm our findings and recommendations

INTRODUCTION

The Advanced Weather Interactive Processing System (AWIPS) is being developed to replace the antiquated Automation of Field Operations and Services (AFOS) system, which processes meteorological data and distributes it to National Weather Service field offices and other facilities AWIPS is intended to provide forecasters with modern interactive processing and display capabilities It will provide the capability to acquire data from the advanced observing systems coming on-line, including the new Doppler weather radars, the next generation of Geostationary Operational Environmental Satellites (GOES), and the Automated Surface Observing System (ASOS) AWIPS will provide forecasters with tools to rapidly analyze the data, integrate it with the information provided by the weather service guidance centers, and prepare timely and accurate warnings and forecasts for dissemination to the public and the media Estimated to cost over $500 million, AWIPS is the key integrating element of NWS's $4 billion modernization program and is essential to achieving weather service operational improvements and resultant cost savings Thus, it is of the highest priority

BACKGROUND

AWIPS development has been characterized by management instability, sluggish technical progress, substantial cost growth, and protracted schedules The program was originally conceived and managed by NWS However, because of cost, schedule, and technical problems in AWIPS, as well as in the other major systems of the modernization, the Systems Program Office was created in 1991 to manage NOAA's major systems acquisitions In 1994, with AWIPS continuing its pattern of cost, schedule, and technical problems, NOAA returned control of the program to NWS, relegating the Systems Program Office (renamed the Systems Acquisition Office—SAO) to a diminished role

We have conducted two previous inspections of AWIPS In our first inspection, performed during the Definition Phase, we found that NWS's solicitation for the Development Phase was incomplete, disorganized, and ambiguous [1] We concluded that the solicitation (1) would lead to a contract that would be difficult to administer and to disputes that would be difficult to resolve, (2) would not form the basis for an enforceable contract, and (3) did not provide for a coherent engineering process. We recommended that NOAA thoroughly review and revise the solicitation prior to contract negotiations with the objective of obtaining a clear, complete, consistent, and enforceable contract. NOAA did not implement our recommendations, stating that the schedule would permit no further delays

After entering the Development Phase, AWIPS experienced immediate and persistent problems, leading to our second inspection [2] That inspection disclosed that 20 months of AWIPS

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[1] *AWIPS Re-Baselining and Associated Issues*, U S Department of Commerce, Office of Inspector General, Report No SED-4585-2-0001, May 1992

development had yielded little technical progress. In addition to the problems cited in our first inspection, we attributed this to (1) AWIPS having entered the development phase prematurely, without a system design, (2) an environment of inordinate schedule pressure and an inappropriate contractual incentive for schedule acceleration, and (3) the need for improved management and engineering expertise at senior levels both by the contractor (PRC) and in the SAO. We also found that efforts to solve problems on AWIPS had been impeded by NOAA's realignment of organizational responsibilities In particular, control of the acquisition had been returned to NWS, which lacks the capability to effectively manage major systems acquisitions We concluded that NOAA had not developed an approach to AWIPS that was responsive to the management issues

Because of the problems with AWIPS, the Development Phase contract could not be performed and was renegotiated A contract modification was signed in August 1995 with a cost increase of $68 million A major problem has been the extraordinary difficulty NOAA has had in obtaining an acceptable system design, which is essential for making any progress on AWIPS, as well as for renegotiating the contract NOAA's third rejection of the AWIPS system design last November and the need to renegotiate the contract prompted this inspection

PURPOSE AND SCOPE

The objectives of this inspection were to (1) assess issues of concern associated with AWIPS restructuring and contract renegotiations, (2) evaluate the suitability of plans for the production decision, and (3) determine the feasibility of closing field offices before AWIPS becomes available. We originally had planned to determine the status and assess the quality of the AWIPS system design, which was delivered in May. However, because of time-critical issues regarding the schedule and production decisions, we limited our review to several critical portions of the design We found that PRC has adopted an improved method for presenting the design, and we detected no major flaws in what we looked at. In addition, our review of NOAA's comments on the design and our attendance at the system design review indicate that NOAA has found the design to be acceptable

In conducting our review, we met with management and technical personnel from NWS, SAO, and PRC. In addition, we visited three Weather Service Forecast Offices (WSFOs)—one in each of the Eastern, Western, and Southern regions—and also reviewed contract-related documents. Finally, we spoke with personnel at the National Reconditioning Center, which is responsible for maintaining AFOS, regarding its supportability.

Inspections are special reviews that the Office of Inspector General conducts to give agency managers information about operations, including assessments of current and foreseeable problems The objective is to promote effective, efficient, and economical management and to

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[3]*Management and Engineering Problems Halt AWIPS Progress*, U S Department of Commerce, Office of Inspector General, Report No SED-6623-4-0001, September 1994.

detect fraud, waste, and abuse Our work was performed in accordance with the *Standards for Inspections* issued by the President's Council on Integrity and Efficiency

OBSERVATIONS AND CONCLUSIONS

1. NOAA's accelerated schedule for AWIPS is unrealistic and risky

The decision to commit AWIPS to full production based on satisfactory system performance when tested under operational conditions is termed "Key Decision Point 4," or "KDP-4 " NOAA currently has two documented dates for KDP-4, October 1996 and March 1997, but is working toward the former We found that both dates are arbitrary and unrealistic In our opinion, attempting to meet either date will perpetuate the cost, schedule, and technical performance problems that have characterized AWIPS since the Development Phase began in December 1992 NOAA arrived at these dates by planning to perform activities simultaneously that should be performed sequentially, compressing the time to complete design activities, removing critical design activities from the development process, and altering key parameters of its scheduling tool to artificially yield a shorter development time frame

In late 1994, NOAA began analyzing various schedule scenarios based on NWS's AWIPS Incremental System Capability Plan This plan identified the hydrometeorological capabilities for three major milestones—KDP-4, office closure, and reduced office staffing NOAA used a software cost and schedule estimating tool to assist in analyzing schedules The tool estimates software development schedules, taking into account such factors as the amount and complexity of the software, the skill of the personnel, and the characteristics of the hardware.

Before arriving at the October 1996 schedule, NOAA developed three other schedules that projected KDP-4 completion dates of December 1996, May 1997, and March 1997. These schedules were based on the revised development milestones specified in the AWIPS contract modification, estimates of the amount of software to be developed, and variations in assumptions in the scheduling tool.

The December 1996 KDP-4 schedule was developed in late 1994 However, AWIPS was experiencing slower progress than planned in developing the system design, beginning the hardware and software requirements documents, and completing the proposed contract modification In addition, NOAA became aware that the estimated amount of software that the contractor would have to develop would increase, a factor that has a great impact on the schedule NOAA also recognized a need to require additional activities to control system acceptance testing Consequently, the schedule estimate was revised

Taking these factors into account, NOAA's analysis yielded a date of May 1997 for KDP-4 However, some AWIPS technical personnel believed that the software lines-of-code estimate was still too low, indicating that additional software design and development would be needed Due to NWS's concern that a longer schedule would jeopardize the program, no further extensions

were considered, and, instead, analysts were directed to assess the May 1997 schedule to determine how it could be shortened

As a result, the March 1997 KDP-4 schedule was created NOAA achieved time savings by three principal means. First, it increased the parallelism between implementation and integration activities in the first and second builds [3] Second, it allowed for the deployment of the Network Control Facility, the National Meteorological Center, Headquarters, and the Training Center before completing three formal milestones (System Validation Review, Functional Configuration Audit, and Physical Configuration Audit) The purpose of these milestones is to validate that the system meets its functional and performance requirements, to confirm that it is consistent with its design documentation, and to ensure that the test requirements for acceptance of production units are adequate Third, in its scheduling tool for both contractor and government software developers, NOAA assumed skill levels that were higher than those used in previous schedules. NOAA also assumed that skill levels would increase as AWIPS proceeds through the incremental software builds

Excessive parallelism in design activities clearly adds risk, as does deploying systems without adequate assurance at defined milestones that they will perform as intended Consistent with conventional systems development processes and under the process that PRC and NOAA jointly developed for AWIPS,[4] systems are not to be deployed until these milestones have been passed. However, this requirement has been abandoned NWS justified the skill level improvement on the basis that Application Programming Interfaces[5] will be used, proficiency in using the development tools will increase, and the contractor and government now have a better understanding of the design methodology While these factors will improve productivity somewhat, we believe that the skill levels were selected solely as a schedule compression technique. Thus, we believe that the March 1997 schedule is unrealistic.

Nevertheless, NWS decided to make the KDP-4 schedule even more aggressive, and in March 1995 announced the October 1996 date Aggressive techniques were again employed to justify this schedule. The durations of design activities used in preceding schedules were further shortened, and parallelism between design activities was further increased. Major development milestone reviews and the appropriate design documentation were removed from the schedule's critical path These reviews and documentation are vital monitoring and control mechanisms that should be on the critical path, especially in light of the past performance of both PRC and NOAA.

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[3] A build comprises a subset of hydrometeorological and system software that provides end-use capabilities Each build will add to the previous build to increase system capabilities.

[4] PRC, "Overview Presentation AWIPS High-Level Architecture, AWIPS Life Cycle, Model," September 28, 1994

[5] Application Programming Interfaces define the software interfaces used to access shared system-wide software services

At the time of our fieldwork, NOAA and PRC were discussing additional methods to achieve the compressed schedule. One method that has been discussed is the elimination of the Detailed Design Review and its associated documentation. In our draft report, we identified this as an unacceptable risk since this review is the last formal milestone at which NOAA can assess the design to ensure that system requirements are met before coding begins. NOAA has now decided to retain this review.

We believe a significant risk to all of these KDP-4 schedules is the underestimation of the amount of software to develop. While NOAA was developing its schedules, its own software estimates for KDP-4 increased by 128 percent. This increase was not factored into either the October 1996 or March 1997 schedule, nor has its impact on the schedule been determined. In addition, PRC has informed NOAA of a 50-percent increase in its estimate to implement the application user interface and now projects a 95-percent increase over the estimate NOAA used to develop the October 1996 and the March 1997 schedules. We believe the software estimate increase is directly related to PRC's design activities and to the evolution of the AWIPS design. Although PRC has revised its estimate, NOAA has not altered its KDP-4 development schedule.

As noted, development schedules are greatly affected by the lines of code to be developed, and software estimates invariably grow as projects progress. The KDP-4 schedules fail to reflect not only the current lines-of-code estimates, but also the strong likelihood of additional code growth. Although statistical data on code growth are not available, a senior fellow at the Software Engineering Institute recommends adding contingencies of 75 to 150 percent to the lines-of-code estimate when a project is at the high-level design phase.[6] Neither KDP-4 schedule has such contingencies.

The AWIPS schedule has been compressed to the point that any unanticipated design or implementation problems will have a severe impact. NOAA's experience on Pathfinder demonstrates that unanticipated problems will lead to schedule slippage if the schedule is too constrained.[7] The planned six-month schedule for Pathfinder was exceeded by two months, a 33-percent increase.[8] On Pathfinder, the amount of software delivered exceeded the original estimate by 117 percent, the effort to integrate commercial off-the-shelf software was miscalculated, unanticipated difficulties were experienced in linking to NEXRAD, and PRC's testing organization and policies were inadequate. In contrast to AWIPS, Pathfinder was characterized

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[6]Watts S. Humphrey, *Managing the Software Process*, Addison-Wesley, 1989, pp. 93-96.

[7]Pathfinder is a prototyping activity used to implement, deploy, and operationally test selected AWIPS capabilities.

[8]NOAA indicated in its response that we incorrectly stated that an eight-week schedule delay had occurred on Pathfinder when, in fact, the actual delay was seven weeks. However, during our inspection, both NWS and SAO officials reported an eight-week delay, although neither could provide documentation to allow us to compare the planned and actual schedules.

by a small number of well-defined requirements, a streamlined development approach, and a more realistic schedule. In addition, it was staffed with PRC's most experienced and talented personnel. Although NWS says it plans to use the lessons learned from Pathfinder to reduce risks on AWIPS, it has not used important lessons from Pathfinder in developing the AWIPS schedule

Although NWS officials assert that the software growth did little to cause Pathfinder's schedule overrun, neither NWS nor PRC has completed any analysis of this issue. PRC is performing the analysis to identify the lessons learned on Pathfinder. NOAA should determine what factors led to the underestimation of the Pathfinder software and to the two-month schedule delay and apply this information to more accurately estimate the AWIPS schedule. We believe that a key lesson to be applied to AWIPS is that *all* of the schedule growth occurred in the work that was to be completed in the last three months—code, integration, and test. Thus, while Pathfinder appeared to be on schedule throughout the entire design phase, it encountered substantial slippage during implementation.

NOAA did not use sound management or engineering judgment in arriving at the KDP-4 schedule. Instead of using its scheduling tool and further analysis to render a reasonable schedule, NOAA crafted assumptions to yield a predetermined result. Scheduling tools can be off by 500 percent or more if they do not use assumptions appropriate to the experience of the specific development organization,[9] and NOAA's assumptions are arbitrary and insupportable. As with its approach to previous AWIPS schedules, NOAA has decided on a timetable that is neither realistic nor achievable. And like previous AWIPS schedules, this schedule will lead to a breakdown of development discipline, minimizing such activities as testing, documentation, and reviews. Experience has shown that accuracy and quality will be compromised in a futile attempt to meet schedule, leading to unnecessary and excessive errors and expensive rework. NOAA is pursuing a high-risk, irresponsible approach to developing this vital, expensive system.

Follow-up

During a meeting to discuss our observations and conclusions, the Assistant Administrator for Weather Services indicated that we lacked an adequate understanding of the schedule because we had not met with the senior NWS AWIPS manager to discuss it. This manager expressed a similar concern about our lack of understanding. We acknowledged that we had not met with the Acting Systems Modernization Manager to discuss the technical details of the KDP-4 schedule. During the inspection, we interviewed SAO management and technical personnel who performed the schedule analysis and reviewed technical information that formed the basis of the December 1996, May 1997, March 1997, and the October 1996 KDP-4 schedules. We agreed to meet with the Acting Manager to discuss the KDP-4 schedule.

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[9]Humphrey, *Managing the Software Process*, p. 109.

Our meeting with the Acting Systems Modernization Manager provided no additional information concerning the formulation of the October 1996 KDP-4 schedule In fact, she could not explain what factors allowed the KDP-4 schedule to be shortened from May 1997 to October 1996, when the lines-of-code estimate remained the same Furthermore, we questioned the current lines-of-code estimate used to determine the October 1996 schedule based on the 117-percent code growth in the Pathfinder development and the 95-percent code growth projected by PRC She replied that NWS does not believe the most recent PRC code growth estimate

The Acting Systems Modernization Manager discussed the incremental, evolutionary approach for the development of AWIPS and NWS's goal to deploy hydrometeorological capabilities to field offices as quickly as possible She stated that because of past schedule delays, pressure is growing to show progress, and field office personnel have lost confidence in NWS's ability to acquire AWIPS She believes the October 1996 KDP-4 schedule is realistic and can be met However, she also stated that if capabilities planned for the KDP-4 milestone *cannot* be implemented by October 1996, NOAA will seek the KDP-4 decision anyway based on whatever capabilities are available In our opinion, this is another example of the project's being driven by excessive schedule pressure

We also met with the Deputy Assistant Administrator for Modernization At the meeting to discuss our observations and conclusions, he had described the software development process that PRC would use in the renegotiated contract as "code a little, test a little " Since this process was not described in the renegotiated statement of work and since he only described it in very general terms at the meeting, we wanted to follow up. Based on our follow-up meeting, we found that "code a little, test a little" means to define numerous small software builds with a large amount of parallelism We discussed the risks of excessive parallelism and compressed development schedules on software development activities. We stated that an incremental, evolutionary approach can be an effective systems development method, but a realistic development schedule with carefully planned parallel development activities and adequate durations is also needed

He indicated that if the schedule is too short, it will just take more time and that software schedules are never met anyway We explained that if development schedules are overly compressed, design, implementation, and testing activities will be rushed to the point that requirements may not be met, software quality may be poor, and inadequately designed components may have to undergo redesign Furthermore, software development ultimately will take longer and be more expensive than if a realistic schedule were used While the Deputy Assistant Administrator for Modernization did not accept our point of view, he did, however, concur with our position that the October 1996 schedule most likely will not be met

He also stated that in the process of completing contract negotiations, the development process, as defined in the recent contract modification, may be altered He would not elaborate on the anticipated changes, but indicated that they may reflect the software development process used by the Forecast Systems Laboratory on the FX-Advanced prototype system While the process used by that laboratory may be adequate for a small team developing a prototype system, we believe this methodology will not be adequate for AWIPS development because of its technical and

management complexities We strongly oppose changes in the development process that hamper the government's ability to manage and the contractor's ability to evolve and convey its design Sacrifice of needed control and rigor are not justified for the false expectation of schedule compression

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Synopsis of NOAA's Comments

NOAA disagreed with our conclusion While acknowledging that the AWIPS schedule is aggressive, NOAA contended that it is achievable. NOAA stated that the October 1996 schedule was derived from such factors as program experience, improved understanding, better estimates, and application of the new AWIPS life-cycle engineering model Furthermore, NOAA claimed that our analysis of the AWIPS schedule is flawed, that we overstate the potential risks to the acquisition, and that appropriate management and technical measures are in place to effectively meet the October 1996 KDP-4 schedule

OIG Discussion

We find NOAA's response to be disingenuous since AWIPS development activities are already falling behind, and NOAA is now reassessing the schedule NOAA currently is planning to delay development milestones for the first two builds that precede the KDP-4 decision and for the first two Pre-Planned Product Improvements that follow KDP-4 Improbably, however, the schedule for the October 1996 KDP-4 milestone remains unchanged Delaying development milestones while maintaining a fixed KDP-4 date further compresses the effective time to design, implement, code, integrate, and test the software This will substantially increase development risks. We view NOAA's decision to maintain the KDP-4 milestone as an attempt to obscure the development schedule delays and to claim, unrealistically, that the overall AWIPS schedule has not changed

In its response, NOAA touted its approach of using small teams of "knowledgeable" engineers working closely with the contractor to manage the development effort and to remain technically current with the design as it evolves NOAA, however, became concerned about potential delays in the AWIPS schedule only two weeks before the detailed design review (i.e., completion of the detailed design) for build one and the build design review (i e , completion of the preliminary design) for build two Given the involvement of the government engineers, we question NOAA's lack of awareness of the status of the design activities and of the technical issues causing the delays earlier and, thus, the effectiveness of NOAA's management approach

Although schedules for the software development milestones preceding KDP-4 are being extended, until recently, neither NOAA nor the contractor acknowledged that the October 1996 KDP-4 milestone was in jeopardy or was unrealistic However, during a formal progress review held on January 17, 1996, PRC expressed concerns about meeting KDP-4 on schedule and indicated that it had underestimated the effort required for the first of the two builds that comprise

KDP-4 As a result, PRC has delayed all but minimal work on the preliminary design of the second build in order to apply additional software engineering resources to the first, which is also behind schedule Work on the second build was to have started in mid-November

Clearly, NOAA will have to defer the development of both meteorological and system infrastructure capability to later builds if it is to meet the KDP-4 schedule If so, the KDP-4 decision would be made with less capability than planned for during the contract renegotiation Section III of this report discusses our serious concerns about NOAA's plan to proceed with the KDP-4 decision based on the limited set of capabilities defined during contract renegotiation Thus, we would also be opposed to any strategy that defers capabilities to subsequent builds for the purpose of meeting the October 1996 KDP-4 milestone

The current delays are associated with high-level and detailed design activities We expect further delays as AWIPS development moves into coding and testing Historically, software development projects encounter their most severe technical problems during coding and testing because during this phase, the software design evolves into working code that must compile, link, execute, and meet the specified requirements We believe that the unrealistic development schedule before coding and testing will lead to a detailed design that is immature, incomplete, and possibly flawed This will exacerbate the normal problems encountered during coding and testing and result in significant technical issues, cost growth, and delays

NOAA's experience on Pathfinder illustrates why we expect significant delays The software architecture for the Pathfinder's hydrometeorological applications is much simpler than the AWIPS architecture In Pathfinder, these applications stand alone and require minimal interaction with the system infrastructure software. AWIPS, in contrast, requires the design of a highly integrated client/sever software architecture, which is more sophisticated and complicated than Pathfinder. Therefore, the software design issues on Pathfinder were much simpler than those that will be encountered on AWIPS Moreover, unlike AWIPS, Pathfinder was on schedule during both the build design and detailed design phases Nevertheless, NOAA experienced schedule growth of 29 to 33 percent on Pathfinder due to a seven- to eight-week delay during the coding and testing phase

Our analysis of the AWIPS schedule history clearly illustrates the unwise and risky decisions made by NOAA to accelerate the schedule and to justify the October 1996 KDP-4 milestone. Nevertheless, NOAA argues that it is moving forward with the NWS modernization aggressively and responsibly and that further delays in the transition to AWIPS would affect operations. We understand NOAA's frustration with the AWIPS delays and with its inability to provide modernized data to the forecast offices NOAA's strategy to accelerate the development schedule to recover from the lack of technical progress and to expedite the availability of modernized data to forecast offices explains its fierce defense of the October 1996 schedule However, we believe that NOAA's strategy is flawed and will substantially increase the AWIPS acquisition risks We continue to maintain that the AWIPS schedule should be based on sound technical and management factors that yield a realistic, achievable schedule

II. AFOS can continue to support NWS operations, making AWIPS acceleration unnecessary

NWS officials state that AWIPS must be deployed quickly because operations will be harmed by the fragile condition of AFOS, the inability to provide field forecasters with improved meteorological data, and the inability of AFOS to visually integrate and overlay meteorological data Our analysis of the current operational condition of AFOS and the availability of new data contradicts NWS's pessimistic view We found that current NWS operations are being successfully performed using AFOS augmented by other meteorological and sensor systems Furthermore, we believe that AFOS can support future operations at least to the year 2000 Thus, AWIPS development should not be needlessly or recklessly accelerated

A AFOS is effective and supportable

Since AFOS was commissioned in 1982, many enhancements have been made to increase its capability, maintainability, and reliability Hardware enhancements have been made to the AFOS systems at Weather Service Forecast Offices, Weather Service Offices that will be transformed into future Weather Forecast Offices, River Forecast Centers, regional and national centers, and the Systems Monitoring and Coordination Center at NWS headquarters

Two major enhancements, known as System Z and Hawk, replaced obsolete hardware with modern, more capable, faster hardware The System Z enhancement, which was deployed to all of the sites listed above, replaced the processor responsible for handling AFOS communications, replaced hardware to allow increased communication bandwidth, and replaced the disk storage system with a faster, higher capacity disk device. The Hawk enhancement, which was deployed at Weather Service Forecast Offices, River Forecast Centers, and national centers, replaced an obsolete processor with a more capable, faster processor responsible for executing forecaster commands and handling data base management requests.

While these enhancements have improved AFOS's capability and lengthened its operational life expectancy, other hardware components have not been replaced. These include asynchronous and synchronous communications components, multiplexers and demultiplexers, the text display terminal, and the graphical display terminal. However, our field work indicates that there are adequate spare parts, sources for spare parts, and the necessary skills to maintain the AFOS hardware, at least to the year 2000.

Weather service offices that will be closed through modernization have not received the System Z and Hawk enhancements and continue to operate using obsolete hardware We do not view this as a risk to operations since operational responsibilities are being transferred to the modernized offices and the importance of the offices selected for closure is diminishing We agree with the decision not to upgrade AFOS hardware at offices slated for closure

NWS asserts that, due to system limitations, AFOS does not provide field offices with improved meteorological data We agree that AFOS has constraints in such areas as communications, data

storage, and display capabilities that limit major improvements However, AFOS provides meteorological data that is essential to forecasters and to weather service operations, and is augmented by systems that provide forecasters with meteorological data and analysis tools. Field offices have access to data that is much better than that available just five years ago.

B. Improved meteorological data is available

Improved meteorological data is provided to field offices by systems being fielded to modernize the weather service—such as NEXRAD, the Automated Surface Observing System (ASOS), local ground observing systems (mesonets), and National Meteorological Center (NMC) forecasting guidance—and by tools to interpret gridded data from the NMC atmospheric prediction models. NEXRAD provides substantial improvements in the detection and tracking of severe weather ASOS and local mesonets allow weather offices to obtain the latest meteorological and hydrological surface conditions The NMC forecasting guidance is based on the results of the atmospheric prediction models and is used to formulate office forecast products In addition, field offices are obtaining the gridded model data and are using the NMC-developed Personal Computer-Gridded Display and Diagnostic System (PC-GRIDDS) tool to analyze the dynamics of the atmosphere

The information derived from the gridded model data using PC-GRIDDS overshadows any of the atmospheric prediction model data available on AFOS Minimal meteorological data from the atmospheric prediction models is available on AFOS in the form of static graphic displays and alphanumeric data In general, forecasters use the AFOS information to provide a global and hemispheric context of the atmosphere and PC-GRIDDS to analyze specific concerns about the atmosphere. Some examples include determining if conditions exist for the development of thunderstorms and the likelihood of their becoming severe, the occurrence of heavy rainfall and snowfall, movement of weather phenomena, and severe turbulence.

At this time, weather offices do not obtain the gridded model data over an NWS communications circuit dedicated to the distribution of this data. Rather, they obtain the data in various ways, including the Internet or direct communications with file servers located at Western Region Headquarters, NMC, or other sites Although NWS lacks control over transmission of some of the data and cannot ensure its availability, experience in the field indicates that it is a dependable, productive interim measure

While AFOS does not support the integration and overlaying of meteorological data for viewing, NWS offices are effectively producing forecasting products, severe weather warning messages, and advisory messages We agree that the integration and overlaying of meteorological data on a single workstation, which AWIPS will provide, will greatly assist forecasters, especially during severe weather In today's weather forecasting offices, forecasters must use separate systems to view NEXRAD data, satellite data, NMC gridded model data, and some mesonet data Also, personal computers, running various software packages, are used to generate zone forecast messages, severe weather warning messages, and advisory messages, while AFOS is used to distribute these messages

Our assessment shows that weather warning and forecast responsibilities can be met without an adverse effect on operations, and that AFOS, augmented with the systems discussed above, can continue to support operations for at least five more years This is not to say that AWIPS is not needed NOAA must progress with AWIPS because of the limited capabilities and finite supportability of AFOS

Synopsis of NOAA's Comments

In NOAA's opinion, our report incorrectly characterizes current field operations as quite stable and lacking only the integration and overlay capability planned as part of AWIPS In addition, NOAA said that we did not acknowledge that virtually all modernization data sets are significantly degraded in order to allow their transmission over the current low-bandwidth AFOS and GOES satellite distribution systems NOAA also stated that we apparently find it acceptable that weather services provided for the protection of life and property should rely for the next five years on prototype software packages and makeshift communication systems that cannot be supported Furthermore, NOAA indicated that the investment in the new GOES series of satellites will be wasted without AWIPS communications, processing, and display capabilities

Finally, NOAA stated that our report does not recognize the continued investment of resources required to support the current systems with only marginal return As an example, NOAA cited the 1970s vintage printed circuit boards used by the AFOS display modules, which, if AWIPS delays continue, will need to be reengineered because they are no longer available.

OIG Discussion

Based on our visits to field offices and on discussions with forecasters in the field, we understand and recognize that current operations lack AWIPS capabilities beyond just the integration and overlay capability Our report does not, as NOAA implied, contain any indications to the contrary.

Furthermore, we do not conclude that NWS should rely on the present systems (which, according to NOAA, include "prototype software packages and makeshift communication systems that cannot be operationally supported") to provide services for the protection of life and property *for the next five years*. Instead, we note that AFOS, augmented by the other available meteorological and sensor systems, despite the noted shortcomings, *currently* provides services adequate for the protection of life and property and can sustain the current level of service quality until AWIPS can replace AFOS In addition, we know that Weather Service Headquarters, Western Region Headquarters, and the National Meteorological Center make model data available to field offices via systems that can hardly be characterized as "makeshift communications systems that cannot be operationally supported "

NOAA's statement concerning "prototype software" is apparently directed at PC-GRIDDS Although PC-GRIDDS is not an NWS operationally supported computer program, it is used by the majority of Weather Service Forecast Offices to augment AFOS and assist in forecast preparation.

In addition, we recognize that AFOS has constraints in the areas of data communications, data storage, and display capabilities that limit major improvements However, based on discussions with representatives from the National Reconditioning Center, which is responsible for maintaining AFOS, we believe that future operations can be supported by AFOS at least to the year 2000 because of the availability of adequate spare parts, sources for spare parts, and the necessary skills to maintain AFOS NOAA argues that delaying AWIPS will force it to continue with unproductive investments to support AFOS and to reengineer certain components However, investments in AFOS are unavoidable until AWIPS is deployed with enough capability to allow AFOS to be replaced This will occur sooner, rather than later, with a realistic development schedule

We reaffirm our position that NOAA should not accelerate AWIPS development schedule to end its reliance on AFOS A risky schedule will only perpetuate the delays and cost growth that have characterized AWIPS, regardless of its urgency or importance Even considering the continual schedule problems that have plagued AWIPS development thus far, we believe that a realistic schedule will permit NOAA to deliver an AWIPS capability allowing replacement of AFOS and affording access to the full capability of the various modernization data sets in less than five years

III. NOAA's plan for the AWIPS production decision adds risk

According to NOAA's plans, the Secretary of Commerce will be requested to make the decision to commit AWIPS to full production in October 1996. Full production may be approved when system performance has been satisfactorily tested under operational conditions by an organization that is independent of the agency development and user organizations.[10] The goal of the full production milestone, KDP-4, should be to ensure that AWIPS has the capability, stability, and maturity to support weather service operations before deploying it to 144 sites nationwide. Previously, this was also the goal of NOAA, which planned to demonstrate at KDP-4 that AWIPS could replace AFOS.

Because of schedule delays, NOAA now plans for the KDP-4 decision to be made with reduced capability. Under the revised schedule, the capability to replace AFOS and support weather service operations with AWIPS will not be available until about a year after KDP-4 However, based on the assumptions used to establish the KDP-4 schedule and subsequent milestones, we believe that these milestones are also unrealistic Thus, NOAA plans for the commitment to production to be made without conclusively demonstrating that AWIPS will support operations in the modernized weather service, and with substantial software design and implementation remaining

[10]OMB Circular A-109, "Major System Acquisitions," p 10

In addition, the capabilities currently defined for KDP-4 are not firm Instead, a senior official told us that NWS intends to deploy whatever capabilities are implemented by October 1996 and delay any unimplemented capabilities to subsequent builds Therefore, KDP-4 cannot be viewed as a milestone with specified operational objectives supported by a set of defined capabilities In fact, what is fielded at KDP-4 cannot even be considered a system but rather, a set of disparate capabilities In our opinion, NOAA's KDP-4 strategy is risky, unnecessary, and unwise, as well as counter to the objectives of this milestone.

Because of continuing advancements in computer and network hardware components, we believe the deployed KDP-4 hardware will be obsolete and out of production before AWIPS supports the hydrometeorological capabilities needed to replace AFOS Specifically, NOAA will be forced by technological improvements in workstations, file servers, communication processors, and other communication hardware to operate field offices with obsolete equipment that may not be supported by the vendor or to procure replacement components that will increase overall AWIPS costs Since the award of the AWIPS contract, major improvements in hardware have already occurred Processor and communication components originally planned for AWIPS have become technologically dated and some will soon be out of production Because of changes in technology and additional requirements for processor and communications capacity, the recent contract modification upgrades the AWIPS processor and communication hardware with the latest products

Because of the likelihood of obsolescence, NOAA should delay hardware selection and procurement for nationwide deployment until sufficient hydrometeorological capabilities are available to replace AFOS This strategy will allow NOAA to maximize improvements in technology, minimize the capital investment in equipment, and ensure that the AWIPS hardware will support the hydrometeorological applications needed for field office operations and planned future upgrades However, we would support deployment to a limited number of sites of the currently-defined KDP-4 capabilities and subsequent builds leading to the replacement of AFOS. Such limited deployment would be extremely valuable in providing operational experience and feedback to NWS and the contractor.

Because AWIPS KDP-4 hydrometeorological capabilities will be limited, a substantial amount of design and development of both hydrometeorological and system infrastructure software will continue while AWIPS is being fully deployed. For example, PRC estimates that after the KDP-4 milestone, about 204,000 additional lines of non-hydrometeorological code and 695,000 of hydrometeorological code will be developed These estimates represent a 98-percent increase in the non-hydrometeorological code and a 230-percent increase in the hydrometeorological code If the software that must be added after KDP-4 degrades hardware performance, hardware modifications would be necessary, affecting all AWIPS sites However, if hardware modifications are found to be necessary before full deployment, only a limited number of sites would be affected

As noted, the current KDP-4 approach is based on NWS's Incremental System Capability Plan. This plan was developed in response to an AWIPS Independent Review Team finding that the planned incremental software builds were too large and on its recommendation that there be a greater number of smaller builds.[11] In a briefing to the Department's Major Systems Oversight Committee, NOAA officials stated that they agreed with the review team, indicating that they would redefine build contents to increase the number of builds, develop build plans, and formulate detailed build schedules.[12] In doing this, however, they also reduced the capabilities that will be provided at KDP-4, an action *not* recommended by the review team

We believe the hydrometeorological capabilities for KDP-4 have been reduced because of pressure from the Department and NOAA to expedite AWIPS development and deployment. Because AWIPS is far behind schedule with minimal progress made since contract award, this acquisition is under intense pressure to demonstrate results. Therefore, we believe the plan to deploy AWIPS with minimal hydrometeorological capabilities is designed to ensure the continuation of the AWIPS acquisition, but the limited system deployed under this plan will not replace AFOS

Field offices are currently operating with a cumbersome but workable array of systems, which are used to obtain, analyze, and communicate hydrometeorological information. Field office personnel must therefore be proficient with several systems that work differently. Deployment after KDP-4 will worsen an already complicated office operation, yet will not allow replacement of AFOS as the central system for forecasting and communicating weather products. The planned capability for KDP-4 will allow the removal of hardware only for the communications and display of GOES satellite information. Additionally, NWS will have to allocate resources for the maintenance and operation of the AWIPS hardware and software, while also maintaining AFOS and developing additional AWIPS capabilities

User acceptance is critical to the success of AWIPS and depends on the capabilities provided, their ease of use, and the stability of the user interface. At KDP-4, however, capabilities will be minimal, the likelihood of performance problems will be high, and as NWS has indicated, the user interface is likely to change. Thus, as currently defined, KDP-4 could jeopardize user acceptance of AWIPS.

KDP-4 should comprise all capabilities needed to allow the replacement of AFOS. Because it will be time consuming and costly if AWIPS must be redesigned and hardware modified due to inadequate testing before deployment, it is essential that operational testing be thorough and independent. NOAA intends to have NWS, led by the Office of Systems Operations, and PRC personnel conduct the test, with assessment of the test plans, test conduct, and test results performed by an independent organization, such as a federally funded research and development center. Because AWIPS is already dangerously schedule driven, pressure will be intense to

[11] AWIPS Independent Review Final Report, June 29, 1994

[12] "Plans for AWIPS Restructure," June 21, 1994

overlook or defer problems identified in operational testing. Therefore, independence is of the utmost importance. However, although concrete plans for operational testing should already have been developed at this stage of AWIPS, NOAA has no such plans, nor has it identified what organization and approach will be used to assure independence.

As we have reported, AWIPS entered the development phase prematurely, without a system design [13]. At that time, the contractor's software development capability and system development process should also have been firmly established, but was not. Consequently, a 2-1/2-year remedial effort was needed to develop a system design, and Pathfinder was undertaken, in part, to assess whether PRC had the necessary skills and capabilities to develop AWIPS and to improve its development process. The damage to technical progress and schedule of this premature milestone commitment has been severe, with delayed schedules, increased costs, and the need to renegotiate the contract on a sole-source basis. The delays in staff reductions that will result from the AWIPS delays will drive costs even higher. Given the complexity of AWIPS and the large commitment of resources engendered by the production decision, it is essential that this decision be made on the basis of sufficient, accurate information. However, we do not have confidence that NOAA's plans for KDP-4 are sound. Before committing funds for deployment, NOAA should ensure that the AWIPS hardware configuration and software implementation meet NWS's functional, performance, and operational requirements for supporting weather service operations, leading to the replacement of AFOS. It also should ensure that the deployment plans are sound and can be implemented within the planned budget and schedule. To ensure that the production decision can be made without undue risk, NOAA should immediately develop specific plans for operational testing, incorporating an approach that will ensure independence.

Synopsis of NOAA's Comments

NOAA defended its plan to proceed with the KDP-4 decision using an AWIPS configuration that supports minimal hydrometeorological capabilities. NOAA described the two alternatives it had considered. The first was an AWIPS configuration supporting the full level of capabilities required to replace AFOS. The second was a configuration with an incomplete set of capabilities, including radar, satellites, models, and training. While NOAA acknowledges that additional capabilities must be developed and deployed beyond the KDP-4 milestone, it believes there is not a large risk associated with their development. NOAA believes it is more prudent to proceed with nationwide deployment of a small set of capabilities in order to capture their benefits in operational use, as well as to acquire experience that cannot be obtained in a test bed or at a limited number of sites.

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[13] *Management and Engineering Problems Halt AWIPS Progress*, pp. 4-6.

OIG Discussion

The response addressed our technical concerns superficially and did not alter our technical assessment of the risks Therefore, we continue to believe that NWS should redefine the KDP-4 milestone to include the functional capabilities required to support office operations to the level that will allow AFOS to be replaced prior to moving forward with the nationwide deployment of AWIPS

This acquisition has experienced many technical and management problems that have impeded development progress and increased cost Before the contract renegotiation, the planned functional capabilities of AWIPS at the KDP-4 milestone would have allowed AFOS to be replaced In addition, NWS planned to formally perform operational testing to ensure that AWIPS would support office operations and to ensure no degradation of weather services However, because this acquisition has experienced severe schedule delays, NOAA substantially reduced the capabilities of AWIPS at the KDP-4 milestone, abandoned the formal operational test, and designated the second Pre-Planned Product Improvement build to contain the required capabilities to replace AFOS in order to establish an earlier KDP-4 milestone date NOAA's response clearly describes a plan to expedite the availability of the modernized data to forecast offices at the expense of increasing AWIPS acquisition risks In our view, this approach will further increase cost and delay

Due to continuing delays and NOAA's goal of reaching KDP-4 rapidly, we believe that some capabilities currently scheduled for completion before KDP-4 will be deferred to future builds As we have discussed, the KDP-4 milestone should be used to ensure AWIPS has the capability, stability, and maturity to support weather service operations before beginning nationwide deployment However, the currently planned KDP-4 milestone will not do this, and if NOAA defers additional capabilities, the risks will substantially increase

In its response, NOAA described three approaches it is using to manage KDP-4 risks: (1) engineering activities, (2) the selection of KDP-4 capabilities, and (3) NOAA's risk reduction activities. However, we do not accept NOAA's assertion that these approaches will be effective. We agree that engineering activities are important and will benefit the design and implementation of AWIPS. However, these activities cannot adequately reduce the risks associated with NOAA's KDP-4 plan when large amounts of hydrometeorological and system infrastructure software remain to be designed, implemented, integrated, and tested NOAA stated that the KDP-4 capabilities were selected to stress the system with a high volume of NEXRAD and GOES data and to represent the complexity of the hydrologic forecast system. While the processing required for these capabilities will provide useful performance information, it is of limited use in determining the risks associated with software that has not yet been implemented and is essential for office operations in the post-AFOS era Finally, NOAA indicated that its risk reduction activities will minimize the KDP-4 risks In fact, there is only a loose relationship between NOAA's risk reduction activities and the development of AWIPS While NOAA's prototype implements "key AWIPS functions," the design and implementation of the underlying system

infrastructure software and the integration of the "AWIPS functions" to the infrastructure software are significantly different from what PRC is developing for AWIPS

IV. NOAA should seek opportunities to accelerate office closures

The principal function of the field offices slated for closure is to provide weather warnings NEXRAD radar coverage permits this function to be transferred from these offices, allowing them to be closed However, NWS has unnecessarily made AWIPS commissioning a condition for closing field offices [14] Because AWIPS has experienced continual delays and its schedule remains uncertain, linking the schedule for closing offices to AWIPS will delay and diminish any cost savings to be realized from closure

In the modernized weather service, WFOs will include new offices, as well as former WSFOs and WSOs (referred to as "spin-up" offices) at which NEXRAD systems have been installed Field offices slated for closure are referred to as "spin-down" offices Currently, the weather service is hiring term employees to augment the staff at offices slated for closure and will continue to do so as long as there is a need to replace permanent staff members who are reassigned to the field offices at which the NEXRAD systems are being installed Whenever possible, NWS is reducing staffing levels at spin-down sites We support this staffing reduction, but believe that more aggressive actions can be taken

Under the current NWS office structure, WSFOs are responsible for preparing forecasts for the areas served by the smaller WSOs, with which they exchange information via the AFOS communications network The WSOs issue warnings for their area of responsibility and provide weather information to local emergency managers As the modernization progresses and NEXRAD systems are commissioned at WSFOs and spin-up WSOs, WSFOs will retain forecasting responsibility, while the spin-up WSOs can assume warning responsibility for the areas served by spin-down WSOs Office closure can thus proceed before AWIPS is available without degradation of services, and without additional AFOS hardware

Weather service officials maintain that field offices cannot be closed until AWIPS is commissioned because of the limitations of AFOS They argue that AFOS (1) is antiquated and fragile, (2) does not provide the requisite site backup capabilities, and (3) does not provide for the dissemination of important weather information Hence, they remain adamant that AFOS cannot support the closure of field offices. However, as discussed previously (see page 10), we believe that AFOS can sustain weather service operations at least until the year 2000 Our analysis also shows that site backup within the AFOS system is not a major issue when considering office closure. This is because all offices in each region receive the same AFOS information, therefore, a new backup site can be designated when an existing one is closed With regard to dissemination, the NOAA Weather Wire and NOAA Weather Radio are currently the primary means of disseminating information to local communities and can continue to perform this function As discussed

[14]Commissioning is the formal acceptance of a new system in its installed and operational configuration

previously, field offices now have access to data that is dramatically better than that available just five years ago

As a further justification for keeping spin-down offices open until AWIPS is commissioned, NWS maintains that WSOs continue to be an integral part of its structure and that spin-down WSOs are a vital link to the communities they serve However, the functions that the spin-down offices perform are independent of AWIPS and will ultimately be transferred to permanent offices Some offices currently remain open solely to augment ASOS, a responsibility that the Federal Aviation Administration will assume, and they perform no public functions such as issuing warnings Thus, NWS should establish policies, procedures, and schedules for expediting the transfer of responsibilities from the spin-down WSOs to permanent offices For each spin-down office, NWS should identify any alternative approaches, such as re-routing of local communications circuits, to allow office closure in the absence of AWIPS Any spin-down offices that need to stay open because of unique circumstances should be justified on a case-by-case basis

The performance of the NEXRAD systems is a key factor that makes office closure feasible Over 100 NEXRAD radars have been installed and over 60 have been commissioned Performance of these radars has met or exceeded expectations Recently, in response to concerns about the adequacy of coverage provided by the NEXRAD system in the continental United States, the National Research Council (NRC) released a report, which concludes that weather services on a national basis will improve substantially under the currently planned NEXRAD network largely as a result of comparable or improved radar-detection coverage over most of the country.[15] Although the report identifies several localities with the potential for degradation of radar-detection coverage capability, it points out that degradation of such coverage does not necessarily mean degradation of weather services. The report also provides a process for evaluating these locations.

NRC's report concluded that the ability to issue accurate and timely warnings at the sites analyzed has improved substantially since the introduction of NEXRAD. NRC noted significant improvements in the probability of detection of severe storms, the false alarm rate for storm detection, as well as lead times for tornadoes and flash floods. In addition, services are expected to improve further as forecasters gain experience with the system, forecasting methods are streamlined, and algorithms are refined. Improvements in service should also be realized as a result of the availability of products from radars on the network nearby a WFO's service area. Furthermore, the report concluded that NEXRAD will significantly improve overall storm detection and warning performance

Currently, Public Law 102-567 requires the Secretary of Commerce to certify, according to NWS-specified criteria, that there will be no degradation of weather services to an area as a result

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[15] *Toward a New National Weather Service - Assessment of NEXRAD Coverage and Associated Weather Services*, NEXRAD Panel, National Weather Service Modernization Committee, Commission on Engineering and Technical Systems, National Research Council (June 1995)

of a field office closure According to NWS's criteria, an office cannot close until after the commissioning of AWIPS and decommissioning[16] of AFOS at a WFO that will provide the services formerly provided by the closed office We continue to oppose the requirement for commissioning of AWIPS as a condition of office closure and, furthermore, oppose the legislative requirement for the Secretary of Commerce to certify that there will be no degradation of services to an area prior to closing an office. Because the law and the resultant criteria are unnecessary and expensive, H R 1815, *National Oceanic and Atmospheric Administration Authorization Act of 1995*, was introduced into the House of Representatives, which seeks to repeal the requirement for certification At the time the draft version of this report was issued, H R 1815 had not been presented on the House floor Since then, the *National Oceanic and Atmospheric Administration Authorization Act of 1995* has undergone changes that include reinstating the requirement for certification However, we believe Congress should repeal the requirement for certification Regardless of whether there is such a requirement, AWIPS should not be a condition for office closure

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Follow-up

During our meeting to discuss our observations and conclusions, the Assistant Administrator for Weather Services said that at least three offices will be closed immediately after January 1, 1996, the earliest date for office closure allowed by Public Law 102-567 Therefore, offices will be closed without having AWIPS available At a subsequent meeting, the Assistant Administrator explained that although NWS's criteria for office closure require AWIPS commissioning, it is not a firm requirement for closure at all offices and its applicability will be considered on a case-by-case basis. However, NWS neither has nor anticipates producing a plan that identifies spin-down offices that can be closed before AWIPS is available

The Assistant Administrator also told us that he does not have adequate staff at headquarters or at NWS regions to determine interim means of communications to allow additional offices to be closed before AWIPS is available. We believe that NWS has not realistically evaluated the staffing needed for performing the closure analysis and that the regional offices, with the assistance of the field offices, can conduct the necessary analysis and coordinate closure.

Finally, the Assistant Administrator disagreed that certification requirements should be eliminated, although he believes they should be streamlined He believes that certification is necessary because it provides additional assurance that weather services will not be degraded. In his opinion, without certification, NWS is more vulnerable to budget-driven, arbitrary reductions in funding and staff

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[16]Decommissioning is the removal of equipment from use, following the commissioning of new equipment

Synopsis of NOAA's Comments

NOAA's response included a description of the rationale for transitioning from more than 300 field offices to 118 Weather Forecast Offices. In addition, NOAA summarized the office consolidation and closure certification processes and indicated a commitment to proceed with office closure as rapidly as possible while maintaining essential weather services. NOAA further indicated that our description of the process for transfer of warning and forecast services from one office to another was oversimplified and that we failed to properly represent the office backup and dissemination processes.

OIG Discussion

With respect to the transfer of warning and forecast services, NOAA asserted that our report "... incorrectly assumes that (1) all data to support these services are available on AFOS and (2) all dissemination is achieved through NOAA Weather Wire and NOAA Weather Radio."

Contrary to NOAA's assertion, our report does not assume that all data to support warning and forecast services are available on AFOS. Rather, we point out that field offices today have access to data (from sources other than AFOS) that is dramatically better than that available just five years ago. In addition, Section II.B provides details on sources of meteorological data other than AFOS that are available to and used by field offices to support day-to-day operations. Perhaps NOAA misunderstood our statement, in the context of backup, that "... all offices in each region receive the same AFOS information; therefore, a new backup site can be designated when an existing one is closed."

Furthermore, our report does not assume that all dissemination is achieved through NOAA Weather Wire and NOAA Weather Radio. Instead, it states, "... NOAA Weather Wire and NOAA Weather Radio are currently the **primary** [emphasis added] means of disseminating information to local communities ..." During our inspection, weather service representatives told us that local communications circuits at many field offices provide an important source of hydrometeorological data as well as a means of disseminating information to emergency managers and other community groups. Hence, in our report, we recognize that re-routing of local communications circuits, which NOAA indicated are important for warning and forecast services, as well as for backup, is a consideration that needs to be addressed on a case-by-case basis when designating spin-down offices for closure in the absence of AWIPS.

In summary, we disagree with NOAA's assertion that our assumptions within this section are incorrect.

RECOMMENDATIONS

We recommend that the Under Secretary for Oceans and Atmosphere direct NWS to take the following actions

Recommendation #1

Redefine the AWIPS full production milestone (KDP-4) to include all hydrometeorological capabilities required to replace AFOS and develop a plan to deploy this system to a limited number of field offices for operational testing to validate that these capabilities have been provided before proceeding with nationwide deployment

Synopsis of NOAA's Comments

NOAA disagreed with our recommendation and stated the acquisition risks associated with its KDP-4 plan are acceptable due to its system development and risk reduction activities

OIG Discussion

NOAA's response describes a plan to expedite the availability of modernized data to forecast offices that will increase AWIPS risks and, consequently, increase cost and further delay this acquisition We firmly believe that the KDP-4 milestone should be used to ensure that AWIPS has the capability, stability, and maturity to support weather service operations before beginning nationwide deployment Also, the system development and risk reduction activities identified by NOAA to alleviate risks are vastly overstated and will have minimal effect in reducing risks. Therefore, we reaffirm our recommendation.

Recommendation #2

Within 90 days, develop a plan that ensures independence for the operational test and evaluation of AWIPS at KDP-4.

Synopsis of NOAA's Comments

NOAA said that an independent assessment of the AWIPS Operational Test and Evaluation (OT&E) results will be conducted and that plans for the OT&E and the independent assessment are under development NOAA did not, however, commit to developing a plan within 90 days. Also, NOAA disagreed that OT&E can or should be independently conducted

OIG Discussion

Our recommendation that NOAA develop a plan that ensures independence for AWIPS OT&E is based upon its disregard for OMB Circular A-109, which requires OT&E to be conducted independently of a system's development and user organizations We believe that development of

a plan that ensures independence for AWIPS OT&E is necessary to provide assurance that schedule pressure will not encourage the organization conducting OT&E to overlook or defer problems identified during operational testing NOAA is already late in producing an OT&E plan and should do so promptly.

Recommendation #3

Develop a realistic schedule for development and deployment of AWIPS This schedule should be based on the most recent estimates of lines of code with a contingency for code growth, reasonable skill levels for PRC and government software developers, and a managed, disciplined system development process It should also reduce the excessive parallelism in design and development activities

Synopsis of NOAA's Comments

NOAA rejected our recommendation and analysis NOAA stated that the AWIPS schedule is achievable, that the risks associated with the parallel development are manageable, and that our analysis of the schedule is flawed

OIG Discussion

Despite NOAA's response, development activities are already falling behind schedule, and NOAA is currently reassessing the AWIPS schedule. In fact, NOAA is planning to delay the development milestones for the first two builds preceding the KDP-4 decision and for the first two Pre-Planned Product Improvements that follow the KDP-4 decision Although development milestones preceding KDP-4 are being delayed, NOAA has chosen to maintain the October 1996 KDP-4 milestone We believe that NOAA will reduce the capabilities available at KDP-4 in order to appear to meet its schedule, thereby making this milestone even less meaningful. The current effort to replan the schedule demonstrates that NOAA's response to our concerns is invalid. Therefore, we reaffirm our recommendation that NWS develop a realistic and achievable AWIPS schedule based on sound technical and management factors

Recommendation #4

Eliminate the commissioning of AWIPS as a criterion for office closure

Synopsis of NOAA's Comments

NOAA stated that AWIPS commissioning has never been a prerequisite for closure of Weather Service Meteorological Observatories (WSMOs) or Weather Service Contract Meteorological Observatories (WSCMOs) NOAA agreed to implement our recommendation

OIG Discussion

We are aware that certification criteria for closure apply only to Weather Service Offices (WSOs) and Weather Service Forecast Offices (WSFOs). Therefore, the discussion in Section III that deals with accelerating office closures addresses spin-down WSOs. Apparently NOAA incorrectly assumed that this discussion is also directed toward WSMOs and WSCMOs.

Recommendation #5

Develop a plan and schedule to allow closure of field offices as quickly as possible after warning coverage from commissioned NEXRAD sites becomes available for the areas covered by those field offices. Identify any peculiarities that would justify keeping any field office open on an exception basis.

Synopsis of NOAA's Comments

NOAA agreed to review plans for office closure based on recent changes to NWS modernization plans. The review will consider sites on a case-by-case basis and accelerate planned office closure where possible. NOAA also stated that office closure is based on more than just coverage from commissioned NEXRAD sites.

OIG Discussion

NOAA appears to agree with this recommendation. However, NOAA agreed to review existing plans for office closure, but did not agree to produce a plan and schedule for closing those spin-down offices that can be closed before AWIPS is available.

Additionally, in our report, we state that NEXRAD performance is a *key* factor that makes office closure feasible. Thus we recognize that office closure must be based on more than just coverage from commissioned NEXRAD radar sites. Hence, our recommendation includes identifying any peculiarities that would justify keeping any field office open on an exception basis.

We reaffirm our recommendation.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Washington, D.C. 20230
OFFICE OF THE COMPTROLLER

OCT 27 1995

MEMORANDUM FOR: Frank DeGeorge
Inspector General

FROM: Andrew Moxam

SUBJECT: OIG Draft Inspection Report: Unrealistic Schedule and High-Risk Decisions Continue to Jeopardize AWIPS Success (OSE-7355)

We appreciate the opportunity to respond to your draft report on the impact of scheduling and decision making on AWIPS progress. Our detailed response is attached.

Attachment

NOAA Response
to
OIG Report OSE-7355

General Comments

In recognition of the importance of AWIPS, NOAA and the Department have invested considerable energy and resources into restructuring the AWIPS Program to ensure its successful completion. This restructuring, which included a major renegotiation of the contract with PRC, Inc., was a highly visible process and included input from the General Services Administration, the General Accounting Office, and Department of Commerce staff including the Office of Inspector General (OIG). Restructure plans are based on an evolutionary, incremental system development approach employing a modern, accepted system engineering process.

The restructured AWIPS Program has already demonstrated considerable success. A robust system design that can be extended was developed. It capitalized on state-of-the-art hardware and commercial software while establishing an effective division of responsibility between PRC for the system infrastructure and the Government for the hydrometeorological applications that will evolve through the life of the system. This design has significantly reduced the technical risk in developing and maintaining AWIPS. The PRC Development Phase contract was successfully renegotiated, releasing the Government from liability for many potential claims, while concurrently preserving the integrity of the competitive rates established for Deployment and Operations Phases. Most importantly though, the Program has demonstrated its ability to develop, deploy, and operate a significant AWIPS capability under its Pathfinder effort. This effort successfully employed the AWIPS system development process to deploy systems in three field offices and establish the first phase of the Network Control Facility. While the aggressive schedule set for Pathfinder experienced a small schedule slip (7 weeks), it provided the Program the needed "lessons learned"; these lessons have been factored into future development plans. NOAA believes the differences between the AWIPS system development process and the OIG's ideal process are exaggerated in its report.

NOAA continues to work to achieve the benefits of the NWS Modernization in an aggressive but responsible manner. Delay of the transition to AWIPS-based operations continues to impact the ability of the NWS to capitalize on the investments in the Modernization thus far, and prolongs the costly labor-intensive, interim operations dependent upon obsolete systems. Operational

forecasters are not able to make effective use of the advanced observational data and central guidance products that are now available. Outyear budgets reflect planned savings; further delays would require additional resources.

NOAA has worked extensively to estimate the amount of time required for AWIPS development. Both the Government and PRC used available estimating tools appropriately, but recognized that they were far from perfect. Actual experience by the development organization tends to be the strongest predictor for future efforts. As explained below, NOAA believes that the OIG's views of software development do not take into account the efficiencies possible in modern software development environments. Adoption of what the OIG believes are "reasonable skill levels for PRC and Government software developers"[1] would have predicted that the Pathfinder effort, with the delivered lines of code and the actual resources used, take three months longer than it actually did. NOAA acknowledges that there is some technical risk of schedule slip due to the overlap of certain development steps, but believes that the risks to the NWS Modernization of further unnecessary delays in AWIPS are much greater.

NOAA believes that recent changes in modernization plans, including the planned transfer of ASOS augmentation and backup responsibilities to the Federal Aviation Administration (FAA), warrant a reexamination of office closure plans including their linkage to planned AWIPS deployments. The NWS is undertaking this task. NOAA is committed to reducing the cost of NWS operations as rapidly as possible without degrading services to the Nation.

The restructured AWIPS Program plans reflect the intent to begin nationwide deployment once: (1) the system capability is developed to assimilate and integrate the remarkable new information now available as a result of the large public investment in the modernization; (2) the system is evaluated in the restructured operational environment and the results of a systematic assessment are independently reviewed; and (3) it has been assured that the AWIPS system can be extended to meet all AWIPS requirements. Specific program plans designed to achieve these goals exist or are currently under development. These efforts are not acknowledged by the OIG report.

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[1] An "effort adjustment factor" of 1, where 1 is nominal.

Observations and Conclusions

I. NOAA's accelerated schedule for AWIPS is unrealistic and risky

The OIG report discusses the development of three distinct AWIPS schedules. As explained to the OIG staff, the detailed analysis of the program schedule began last fall (1994) and concluded during the negotiations of bi-lateral contract Modification 52 (Mod 52), formerly known as Mod B, signed in August 1995. During this period of time numerous schedules were generated and refined as additional information became known. Snapshots of various interim schedules were presented to the Department and other oversight groups. The information used to refine the schedule came from five main sources:

1) improved understanding of the AWIPS system design and the inherent risks to be addressed in its development;
2) better estimates of the software development work associated with this design;
3) experience with Pathfinder development;
4) application of the life cycle system engineering model selected for AWIPS; and,
5) assessment of site installation plans and procedures.

The AWIPS development phase schedule is documented in the Recovery Plan (March 16, 1995 with schedule update issued August 2, 1995) and the Acquisition Plan (AP) with a planned Key Decision Point IV (KDP IV) date of October 1996. This is consistent with PRC milestones reflected in Mod 52. The Recovery Plan has a "Baseline" KDP IV date of March 1997. This date was established in this document as an upper bound parameter for delegation of procurement authority only. The AP and the contract clearly show October 1996 as the Program goal.

The OIG report states that schedule risk stems from three areas: the system development process (which includes parallelism between development activities), the removal of critical design activities from the development process and the early deployment of certain systems, and an underestimate of amount of software development effort. The following subsections address these areas.

System Development Process: Restructuring of the AWIPS Program explicitly included the adoption of an evolutionary, incremental system development process[1]. This process, which is correctly referenced in the report, was the basis for Mod 52. It is in

[1]AWIPS Recovery Plan, updated 8/2/95, p.24.

contrast to the "modified" waterfall process previously employed by the program. Restructured program plans, approved by the Department and the General Services Administration, reflect the intent to:

1) evolve the system throughout its life cycle through the use of Application Programming Interfaces and by employing an open-systems, distributed site architecture;
2) utilize rapid prototyping to validate requirements against design and performance issues, as opposed to extensive and often inconclusive paper studies, and incorporate the results of these prototypes into the production system (where possible); and,
3) allow iteration in the development steps as opposed to requiring rigorous completion of one step before proceeding to another.

Additionally, NOAA is managing the development effort with small teams of knowledgeable engineers working in concert with PRC, as opposed to relying on formal deliverables to gain insights into the contractor's development status and issues. This system development approach is consistent with current industry practices and is well documented. See for example, the recent account of the 17th International Conference on Software Engineering[3].

Moreover, this approach was used very successfully to develop the AWIPS Pathfinder system that is currently providing valuable support to operations at three NWS field offices. As its name implies, the Pathfinder effort was used to gain insight into AWIPS system development and begin the evolutionary development of key AWIPS components (e.g., the satellite broadcast and the Network Control Facility (NCF)). These goals were met by specifically identifying needed changes to AWIPS development, implementation, and operations. The primary areas needing improvement were test facilities and procedures and NCF capabilities. These changes have been incorporated into Mod 52. We are also retaining what worked well with the system development process of Pathfinder. The experienced and talented PRC Pathfinder developers noted in the OIG report, as well as government team members, are now leading the development efforts for future builds. And, similar to Pathfinder, the AWIPS Builds planned to support KDP IV have a substantially reduced number of system level requirements through the use of the AWIPS System/Segment Specification Document. The AWIPS schedule does have overlap between design steps. However, the AWIPS system

[3]Keuffel, Warren, "And Now, the Microsoft Process...", Software Development, August 1995, pp. 29-32.

development process[4] referenced by the report was specifically chosen because it is designed to accommodate overlapping software builds.

Critical Design Activities/Early Systems Deployment: We acknowledge that the Headquarters Development and Test systems will be deployed prior to the completion of Build 1 software. The OIG report identifies this as a risk. However, this early deployment will ensure that development of government software is done using the AWIPS target hardware. This reduces the overall program risk. If this were not done, it would be analogous to not allowing PRC to buy the target hardware for their own development. Also, PRC has proposed, and the government has approved, an early deployment of communications hardware associated with the wide area network (which was largely not addressed by Pathfinder) as well as the Satellite Broadcast Network. This early communications implementation will allow PRC to validate critical aspects of this key component of AWIPS. Sites to be deployed include the NCF, NWS Headquarters, Kansas City Weather Forecast Office (WFO), Missouri Basin River Forecast Center (RFC), NWS Training Center, Tulsa WFO, Arkansas-Red Basin RFC, Salt Lake City WFO, and Colorado Basin RFC. At this time, there are no plans for early equipment delivery to the National Meteorological Center which is mentioned in the report.

The System Validation Review, Functional Configuration Audit, and Physical Configuration Audit referenced in the report are included in the contract as part of Mod 52. Additionally, this modification requires a formal Detailed Design Review as opposed to the informal review that was part of the documented AWIPS system development process. Formal deliveries of design documentation were removed from the critical path but not from the program. Government engineers are working closely with PRC and have day-to-day access to the system development notebooks that guide system development. These large, formal documents will be delivered, as required by the contract, after the engineering level review, thereby, avoiding costly and time consuming republication.

Software Development Effort: In formulating the development phase schedule, various efforts were made to estimate the amount of development work. Such estimation is particularly difficult and is the focus of continuing work by the software engineering industry. To maintain traceability to prior program activities, estimates of software lines of code (LOC) were used with the

[4]Life Cycle Engineering Team White Paper, PRC Document AWP.LCE.WHTPPR, October 6, 1994.

available cost and schedule estimating tool, Costmodeler[5], which uses COCOMO[6] to provide input to schedule development. [It is recognized that other (but still far from perfect) metrics and modeling tools are currently available[7]]. The COCOMO model was developed in the early 1980's with empirical data from software development projects of that era. Significant changes in software development have occurred since. Development has moved from being largely "batch" processing with long turn-around times to being essentially real-time. Efforts by both PRC and the government are continuing to adjust inputs to the COCOMO model to account for the advanced development environment afforded by modern UNIX workstations, the availability of updated development and test tools, and the experience of program personnel. However, it is well recognized by government and industry[8] that the output of such models is very questionable unless the model is calibrated with recent experiences (e.g., the same or similar program requirements, developers, and development environment) of a given organization.

The Pathfinder experience provided useful input to this planning task. The OIG report is correct that the Pathfinder LOC were underestimated by approximately 117%. NOAA recently performed preliminary analysis of the Pathfinder effort. Although the LOC more than doubled, the impact on schedule was 7 weeks or approximately 22% not the 33% given in the report. This includes an estimated 2 to 3 week slip due to inadequate testing resources and procedures. While NOAA is pleased with the performance of PRC and government developers on Pathfinder and believes Build 1 will show improvement, the efficiencies assumed in Mod 52 schedules are more conservative than those experienced in Pathfinder. (For Mod 52, effort adjustment factors of 0.9 and 0.8 for Builds 1 and 2, respectively, were used.) Rerunning the COCOMO model using actual Pathfinder data shows an "effort adjustment factor" of 0.5. (The lower the number, the more efficient the development effort is assumed to be.) Another way to illustrate the same point is: a rerun of COCOMO using the Mod 52 assumptions predicts that Pathfinder would take three months longer to develop than it actually did.

In summary, NOAA acknowledges that the AWIPS schedule is aggressive but believes that it is achievable and that the OIG report overstates the schedule risk.

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[5]Costmodeler, Version 1.0, NASA, JCS, Software Development Branch Users Guide.

[6]Boehm, B., Software Engineering Economics, Prentice Hall, Inc., 1981.

[7]See for example, Dreger, J. Brian, Function Point Analysis, Prentice Hall, Inc., 1989 and Checkpoint 2.3, Software Productivity Research, Inc.

[8]Software Measurement Guidebook, NASA, GSFC, Software Engineering Laboratory, July, 1994.

II. AFOS can continue to support NWS operations, making AWIPS acceleration unnecessary

The OIG report characterizes current field operations as quite stable and only lacking the integration and overlay capability planned as part of AWIPS. The report does not acknowledge that virtually all of the modernization data sets are significantly degraded to enable transmission over the current low bandwidth operational systems (e.g., AFOS for numerical model data and GOES-Tap for GOES data) and that some data (e.g., one minute ASOS data) are not available to operations at all. The OIG report also appears to suggest that it is acceptable for weather services provided for the protection of life and property to rely for the next five years on prototype software packages and makeshift communication systems that cannot be operationally supported (e.g., dial-up connections to universities to access data sets they receive via Internet and other means).

The new data streams now available are planned to provide significant improvement to weather warning operations; however, because of the limitations in the current systems, they cannot be effectively used in warning situations. As an illustration, examine the distribution and use of GOES data in today's operations compared to the capabilities of the GOES satellite and the modest capabilities that exist in Pathfinder. Today, distribution of GOES data are handled by the analog GOES-Tap system, because AFOS cannot handle satellite data. To accommodate the limitations of these lines and the local display system, the 1km resolution digital GOES image data acquired from the satellite are degraded to approximately 40 km resolution. Probably more important, the system can only accommodate two images per hour, with a delay of 30 minutes. With Pathfinder, the full resolution (1km) digital GOES images are sent and received almost in real time. Up to 8 images can be received in one hour. As one field forecaster from the Pittsburgh Pathfinder site recently said, "We can finally use GOES data in warning situations!"

In addition, recent scientific advancements in applications for these new data sets cannot be incorporated into today's forecast and warning operations. Again, using GOES data as an example, the receipt of the digital data stream into NWS operations allows forecasters to see beyond just surface cloud characteristics and derive valuable digital information on site. This is not possible with the GOES-Tap system. The digital signal also allows forecasters to locally enhance cloud features to predict and track severe weather events. More importantly, the digital signal from the new GOES satellites provide forecast and warning parameters in real time such as cloud-top temperatures; digital water vapor information; and air mass

convective information for the determination of severe storm formation. The investment in the new GOES series of satellites will be wasted without AWIPS communications, processing, and display capabilities.

The OIG report does not recognize the continued investment of financial and management/technical resources required to support the current systems with only marginal return. For example, with continued AWIPS delay, it will be necessary to reengineer the 1970's vintage printed circuit boards used by AFOS display modules because they are no longer available. This investment would yield no improvement in operations and would consume scarce monetary, as well as human, resources since AFOS obsolescence precludes support from industry.

In these times of tight fiscal resources, it is incumbent upon us to operate as efficiently as possible. NOAA believes it would be wasteful to delay the benefits of the modernization technology further and to continue investing resources in obsolete systems. As explained in Sections I and III, proceeding with nationwide deployment as planned can be achieved with manageable risk.

III. NOAA's plan for the AWIPS production decision adds risk

NOAA considered two primary alternatives with respect to the level of capabilities to be available prior to the decision for nationwide deployment (KDP IV). The first alternative was to develop the full level of capabilities required to replace the AFOS system. The second alternative was to provide an initial set of new capabilities that capitalize on the large investment in new radars, satellites, models, and training while demonstrating a robust, reliable system that could be extended. The latter alternative was chosen because it:

1) allowed improved weather services to be provided to the nation sooner;
2) provided an earlier and more systematic assimilation of the new technology into operations and allowed time to make needed adjustments both in system capabilities and operational procedures; and,
3) was more cost effective when overall modernization costs (e.g., office closure and target staffing goals) were considered.

Prior to the full-scale production decision, NOAA intends to assure that "AWIPS hardware configuration and software implementation meet NWS's functional, performance, and operational requirements for supporting weather service operations, leading to the replacement of AFOS." The OIG report does not mention that specific program activities are underway to

provide this assurance. These plans fall into three main categories and stem from the need to ensure that the system can be extended to accommodate the post-KDP IV capabilities.

The first category contains the system development activities leading up to KDP IV which address system-wide design and development issues. Specifically, these include overall system design, system bench marking, system performance modeling, and system-wide data modeling. These activities provide assurance that the system is sized correctly and that future interfaces are considered. Development of Application Programming Interfaces to allow the addition of hydrometeorological code is one significant part of the overall system design.

The second category is the selection of the KDP IV capabilities and those planned for deployment post-KDP IV. The KDP IV capabilities were chosen, in part, because they represented requirements that would stress the system. The high volume NEXRAD and GOES data, with demanding processing requirements, stress the system from the perspective of performance. Also, the hydrologic forecast system, which processes data from a myriad of sources, demonstrates that complex applications can be successfully integrated into the system. Furthermore, several of the major AWIPS applications (e.g., Interactive Computer Worded Forecast and Warning Generation) slated for implementation post-KDP IV are in the advanced stages of development and their requirements are being considered in the system design.

The third category represents the on-going risk-reduction activities sponsored by the AWIPS Program. Beginning with the systems environments of the 1980's and concluding with systems compatible with the AWIPS design, virtually all of the key AWIPS functions have been demonstrated. Recently, the Forecast Systems Laboratory has been able to acquire the AWIPS site hardware to prototype a level of capabilities approximately equivalent to the target AWIPS system. This prototype activity is well underway, with plans to deploy a system at the Denver, Colorado, Weather Service Forecast Office prior to KDP IV.

Prior to KDP IV, NOAA plans to conduct an Operational Test and Evaluation (OT&E) at a limited number of sites. This test will validate the operational use of the AWIPS capabilities contracted for under Mod 52. Any changes to these capabilities are expected to be minor and will result from an efficient development process with close user involvement.

While additional capabilities are to be added beyond KDP IV, NOAA believes that these do not represent a large risk. Rather, NOAA believes that it is less risky to proceed with nationwide

deployment and capture both the benefits and the experiences from operational use that cannot be obtained in a test bed or at a limited number of sites.

IV. NOAA should seek opportunities to accelerate office closures

The ability to provide weather services to the nation from the approximately 118 Weather Forecast Offices planned for the NWS Modernization and associated restructuring was predicated on:

1) the planned capabilities of weather observing systems (e.g., NEXRAD, GOES, and ASOS);
2) incorporation of research results into real-time operations through changes in staff composition, intensive education efforts, and implementation of high speed central computers for execution of advanced numerical weather prediction models;
3) advanced system and telecommunication capabilities to acquire and distribute data sets; support for national and local warning and forecast operations, including requisite coordination and backup procedures; and dissemination of warnings and forecasts to local as well as national users provided by AWIPS; and,
4) users' acceptance of new methods of providing weather support (e.g., aviation user acceptance of automated surface weather observing data or emergency management officials ability to function effectively with support from remote locations).

The transition from the original 300 plus offices to the 118 offices has been systematically planned to ensure continued quality warning and forecast services to the Nation. The OIG report greatly oversimplifies the transfer of warning and forecast services. It incorrectly assumes that (1) all data to support these services are available on AFOS (even though the previous section of the OIG report acknowledged that this is not correct) and (2) all dissemination is achieved through NOAA Weather Wire and NOAA Weather Radio. With respect to the former, data from surrounding areas, received via systems other than AFOS, are vital for routine operations and are the basis for providing backup to an adjacent office when needed. With respect to the latter, vital warning information is often provided to the emergency management community through various local communications links.

We would like to clarify the NWS activities with respect to office closure as discussed under the "Follow up" section. Offices not requiring certification under Public Law 102-567 have been closed as quickly as possible as new technologies and restructured operations permit. These offices are not "service outlets"; they provide observational support to NWS operations. The NWS is currently pursuing consolidation certifications in

accordance with NWS regulations found at 15 CFR 946. A consolidation certification allows the portion of the staff associated with the discontinued function (in these cases radar operations) to be reassigned to another location. The NWS has recently consulted with the Modernization Transition Committee (MTC) regarding the first six consolidation certifications. The MTC agreed that these actions can proceed without degradation of services.

With respect to closure certification under Public Law 102-567, the NWS has not yet established final modernization criteria for this type of action. The NWS did provide the National Research Council (NRC) in 1993 with proposed criteria for closure which included AWIPS commissioning as one of the criterion. The NRC endorsed the NWS's proposed criteria in their report Toward A New National Weather Service -- Review of Modernization Criteria, July 1993. However, in December 1993, the NWS chose not to publish proposed criteria for closure (and automation) when it published its relocation and consolidation criteria for public comment in the Federal Register. In that December 6, 1993 notice, the NWS stated, "This notice of proposed rulemaking sets forth the proposed criteria for these actions except for automating and closing field offices. The criteria for those two actions require further development and after notice and public comment, will be published in final form before either of these actions will take place."

The NWS is more than half way through the transition to modernized operations and continues to move aggressively to provide taxpayers the benefits of improved weather services in the most cost-effective manner, in accordance with applicable legislation. Consistent with past practices, the NWS is currently reviewing transition plans based on experience. Over the past six months, NWS and the Federal Aviation Administration (FAA) have been working toward transferring the responsibility for aviation users' requirements for augmentation and backup of ASOS data to the FAA. This arrangement will remove some service responsibilities from certain offices slated for closure over the next four years. Due to this and other significant changes in the situation, the NWS is reviewing all office closure plans on a site-by-site basis. NOAA is committed to reduce unnecessary cost of weather service operations as rapidly as possible while maintaining essential services.

Recommendations

1. Redefine the AWIPS full production milestone (KDP-4) to include all hydro meteorological capabilities required to replace AFOS and develop a plan to deploy this system to a limited number of field offices for operational testing to validate that these

capabilities have been provided before making the decision to proceed with nationwide deployment.

NOAA Response: Disagree. As discussed above, NOAA's current plan provides significant improvements to weather services in a cost-effective manner at the earliest possible time. By incorporating the related system development and risk reduction activities that were not discussed in the OIG report, there is acceptable risk with this approach. Program plans continue to include an operational test of the system capabilities, prior to KDP IV at the 12 field offices scheduled to receive the development-phase AWIPS.

2. Within 90 days, develop a plan that ensures independence for the operational test and evaluation of AWIPS at KDP IV.

NOAA Response: As part of the restructuring of the AWIPS Program, NOAA and the Department plan that an independent assessment of the AWIPS Operational Test and Evaluation (OT&E) results will be conducted.[9] However, we do not agree that the OT&E can or should be independently conducted. Plans for the OT&E and the independent assessment are under development.

3. Develop a realistic schedule for development and deployment of AWIPS. This schedule should be based on the most recent estimates of lines of code with a contingency for code growth, reasonable skill levels for PRC and government software developers, and a managed, disciplined system development process. It should also reduce the excessive parallelism in design and development activities.

NOAA Response: As discussed in Section I, software estimating tools have been used appropriately and extensively for AWIPS. The Pathfinder experience validates that very high software productivity can be achieved using currently available development environments and tools. We believe that the OIG staff has not recognized the efficiencies possible in modern software development. NOAA agrees that there is some risk from the parallelism in the design and development activities but believes the risk is manageable and well worth the effort.

4. Eliminate the commissioning of AWIPS as a criterion for office closure.

NOAA Response: AWIPS commissioning has never been a prerequisite for closure of Weather Service Meteorological Observatories (WSMO) and Weather Service Contract Meteorological Observatories

[9]Acquisition Plan, Revision 1, Advanced Weather Interactive Processing System (AWIPS), July 5, 1995, pg. 22.

(WSCMO). For Weather Service Offices (WSO), the NWS agrees to consider as part of its site-by-site study referenced in the response to Recommendation 5 whether some of these office can be closed without AWIPS.

5. Develop a plan and schedule to allow closure of field offices as quickly as possible after warning coverage from commissioned NEXRAD sites becomes available for the areas covered by those field offices. Identify any peculiarities that would justify keeping any field office open on an exception basis.

NOAA Response: Agree to review plans for office closure based on recent changes to NWS Modernization plans. As noted in Section IV, office closure is based on more than just coverage from commissioned NEXRAD sites. This review will consider sites on a case-by-case basis and accelerate planned office closure where possible.

Detailed Comments

Page i, second paragraph. Reference to the Mod 52 cost increase of $68M implies that the total growth was attributable to problems with AWIPS. In reality, a large portion of the growth was required to meet specific government changes to the SOW for more state-of-the-art hardware and communications. Additionally, all costs for software development were shifted into the Development Phase vice being split between the Development and Deployment Phases.

Page 2, first paragraph, penultimate sentence. The statement is incorrect. NOAA Administrative Order No. 208-3 is quite clear that acquisition responsibilities reside with the Systems Acquisition Office.

Page 2, second paragraph, last sentence. This sentence is incorrect. NOAA did not reject the AWIPS System Design in November, 1994. Rather, NOAA provided PRC with revised system level requirements and asked that they be addressed in an update to the System Design. The system software design was largely unaffected by these changes and remains as presented last fall. Revised requirements, including margins in processing and storage, affected the hardware design. These changes were reflected in the System Design which was finalized in June.

Page 5, first paragraph. The Detailed Design Review is included as part of Mod 52 even though it was recommended as an informal milestone in the AWIPS Life Cycle Process.

Page 5, second paragraph. This is inaccurate. Estimates did not grow by 128%. Rather an early COCOMO run inadvertently omitted a portion of the LOC.

Page 5, last paragraph. The planned Pathfinder schedule is incorrectly stated as 6 months. The schedule was for 7 months, with a delay of 7 weeks. Therefore the stated 33% schedule growth is really 22%. This includes an estimated 2 to 3 week slip due to inadequate test equipment and procedures.

Page 12, fourth paragraph, second sentence. The OIG Report states that "NOAA intends to have the NWS, led by the Office of Systems Operations, and PRC personnel conduct the test..." NOAA does intend to have the NWS, led by OSO, conduct the test. However, the NWS does not intend (nor did it ever intend) to have PRC personnel conduct the OT&E test. The only part that PRC will have in the OT&E will be in the performance of their operational monitoring and maintenance functions. Hence, the contractor's performance in their contractual obligations to perform operational functions will also be under test in the OT&E. Perhaps the OIG is confusing Development Evaluation and Test to be performed by the contractor prior to the OT&E with the OT&E test.

United States General Accounting Office

GAO

Report to the Chairman, Committee on Science, House of Representatives

February 1996

WEATHER FORECASTING

NWS Has Not Demonstrated That New Processing System Will Improve Mission Effectiveness

GAO/AIMD-96-29

GAO

United States
General Accounting Office
Washington, D.C. 20548

Accounting and Information
Management Division

B-266117

February 29, 1996

The Honorable Robert S. Walker
Chairman, Committee on Science
House of Representatives

Dear Mr. Chairman:

This report responds to your request concerning the National Weather Service's (NWS) Advanced Weather Interactive Processing System (AWIPS). AWIPS is an information processing system to support local weather forecasters in acquiring meteorological data from state-of-the-art weather observing systems and national weather models, analyzing these data, and disseminating the resulting forecasts and warnings to the public. AWIPS, which NWS estimates will cost about $525 million to develop and deploy, is to be the centerpiece of NWS' massive, $4.5 billion modernization and restructuring program.

As agreed with your office, our objective was to determine whether NWS' process for developing AWIPS has demonstrated that all proposed system capabilities will contribute to promised modernization outcomes—improved forecasts, fewer weather offices, and reduced staffing levels. Appendix I provides a detailed explanation of our objective, scope, and methodology.

Results in Brief

NWS has yet to demonstrate that all envisioned AWIPS capabilities are needed to meet NWS' three stated mission improvement goals of better forecasts, fewer weather offices, and lower staffing levels. In short, AWIPS' 22,000 requirements, such as "zooming-in" on displayed images and vividly coloring areas of intense weather, are to provide a collection of roughly 450 higher order capabilities, such as viewing and manipulating images. However, NWS has not justified these higher-level capabilities on the basis of mission impact. In the absence of such evidence, NWS runs the risk of spending money for AWIPS capabilities that do not contribute to accomplishing NWS' mission more effectively, efficiently, or economically.

To NWS' credit, it has clearly shown that a replacement for the obsolete information processing, display, and communication systems currently used by NWS field offices is sorely needed. Additionally, NWS has performed several valuable requirements definition and validation activities. For example, NWS has effectively used system prototyping to define users'

needs and demonstrate the technological feasibility of these needs. Further, NWS currently has a process underway for validating that AWIPS' requirements are not duplicative or technologically obsolete. However, these activities do not trace the full complement of planned AWIPS capabilities to NWS' stated mission improvement goals.

Background

Since the early 1980s, NWS has been modernizing its observing, information processing, and communications systems to improve the accuracy, timeliness, and efficiency of weather forecasts and warnings. The $4.5 billion modernization includes four major systems—AWIPS, the Next Generation Geostationary Operational Environmental Satellites (GOES-Next), the Next Generation Weather Radars (NEXRAD), and the Automated Surface Observing System (ASOS).[1] GOES-Next, NEXRAD, and ASOS form the foundation of NWS' observing infrastructure, watching the weather from earth and space. The two orbiting GOES-Next satellites each provide as many as 1,200 digital weather images daily to each forecast office, compared to less than 100 from their predecessors. The almost 150 NEXRADs are to blanket the continental United States and using Doppler radar technology, allow forecasters to see inside weather events to detect motion and dynamics that were invisible to pre-NEXRAD radars. ASOS, which consists of nearly 900 separate ground-based sensor sets, is to provide a portfolio of weather readings, such as temperature and visibility, from more locations and with greater frequency than has been done by human observers.

AWIPS at a Glance

AWIPS is to function as the "central nervous system" of a modernized NWS. That is, it is to be the information processing and display system that forecasters use to integrate, analyze, and graphically view the immense number of weather observations and products that form the basis for each day's weather and river forecasts and warnings. It is also to be the national communications infrastructure for NWS' many forecasting offices and centers,[2] connecting them not only to each other but also linking them to the many users of forecasts and warnings throughout the nation.

[1]According to NWS, the estimated project costs for these four systems are approximately $525 million, $2.0 billion, $1.4 billion, and $351 million, respectively. The remainder of the modernization's cost is attributable to several much smaller projects.

[2]These sites include 119 Weather Forecast Offices, 13 River Forecast Offices, the National Hurricane Center, and the National Severe Storms Forecast Center.

Using AWIPS' advanced processing, display, and communications capabilities, NWS expects to fully capitalize on its new observing systems for the first time. Without AWIPS, these observing systems cannot be maximized because the current Automation of Field Operations and Services (AFOS) computer and communications system and the associated weather office display systems cannot accommodate the mountainous data streams that these observing systems now provide. For example, the current system can only accept two satellite images an hour. With AWIPS, GOES-Next images are to be received in real time, meaning that up to eight images can be received and displayed each hour.

Overview of AWIPS' Expected Impact on NWS' Mission Performance

According to NWS, AWIPS is to contribute to improvements in the accuracy and timeliness of forecasts and warnings as well as streamlining its operations and downsizing its organization. All told, NWS expects that the combined pieces of the modernization will result in the number of NWS field offices dropping from 254 to 119 and the number of NWS staff falling from 5,100 to 4,678. AWIPS is expected to improve forecaster productivity by allowing forecasters to view disparate data sets in an integrated fashion, perform an assortment of scientific computations on these data sets, and graphically display and interact with these data sets. Currently, such activities are generally performed manually as data from the various observing systems are displayed on multiple screens and assimilated by the forecaster. For example, today, when forecasters want to combine radar and satellite images to view weather pattern movements, the images must be manually overlayed on transparencies. With AWIPS, such integration is expected to occur automatically on the AWIPS workstation with a few simple mouse clicks or keystroke commands. In short, AWIPS is to result in forecasters spending less time physically and mentally manipulating data and more time practicing meteorology.

AWIPS History and Status in Brief

The National Oceanic and Atmospheric Administration (NOAA), which is NWS' parent agency, began AWIPS in the mid-1980s to replace AFOS. Since then, NWS has invested considerable time and effort in analyzing and defining AWIPS' requirements, effectively involving users, as we reported in 1993,[3] through hands-on experience with prototypes. In 1992, NOAA awarded the AWIPS development contract to the Planning Research Corporation (PRC). Because of the contractor's failure to deliver an acceptable AWIPS design, NWS renegotiated the contract in 1995, basically

[3]Weather Forecasting: Important Issues on Automated Weather Processing System Need Resolution (GAO/IMTEC-93-12BR, January 6, 1993).

assuming responsibility for development of all hydrology and meteorology application software[4] and assigning the contractor responsibility for delivering the hardware and systems software[5] and for integrating the entire system. To fulfill its responsibility, NWS established joint NWS and contractor applications software (for example, the software that executes atmospheric and hydrological numerical and statistical models, manipulates satellite and radar graphics, etc.) development teams.

NWS' current plans call for building and integrating AWIPS in seven increments.[6] Thus far, NWS and the contractor have installed a very limited version of AWIPS, the first increment, at three sites to gain some experience in developing, testing, implementing, and operating a limited capability AWIPS. This limited version is also intended to validate selected AWIPS architectural features, such as satellite broadcasts and the central communications and system monitoring "hub." NWS has begun development of the second increment. NWS estimates that AWIPS will cost $525 million to fully develop and deploy.[7] Deployment of less than the full AWIPS capability to NWS field offices and national centers is now scheduled to begin in 1996. Full AWIPS deployment is scheduled to begin in 1999.

A Hierarchical Description of AWIPS Functions, Capabilities, and Requirements

AWIPS consists of about 22,000 requirements that have been grouped into about 450 higher-level capabilities. These capabilities are described in the AWIPS System/Segment Specification, commonly referred to as the "A-Spec," which relates about three-fourths of the capabilities to five broad functional areas. The five functional areas are (1) communications, (2) monitoring and control, (3) processing, (4) display and interaction, and (5) data management. The first two functional areas constitute what NWS calls the AWIPS network segment (that is, the national communications infrastructure). The latter three are referred to by NWS as the AWIPS site segment (that is, the functionality applicable to AWIPS sites). Appendix II provides examples of AWIPS capabilities for each functional area. The

[4]Application software is the collection of computer programs that allows a user to perform a specific job or task, such as creating a table, writing a letter, playing a game, or in the case of AWIPS, modeling the flood impact of precipitation data or generating graphical images of weather movement and intensity.

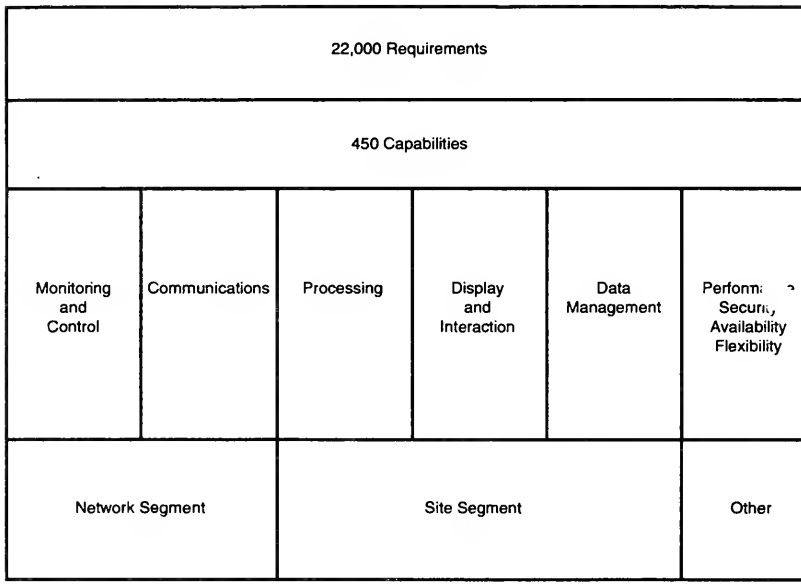
[5]Systems software is the collection of computer programs that manage the computer system's hardware components (for example, central processing unit, disk drives, input and output devices) and that allow the application software to interact with this hardware. Examples of systems software are the operating system, the data base management system, and the compiler.

[6]Incremental development employs a build-a-little, test-a-little approach in which software products are developed in a series of increments of increasing functional capability, that is, software is partitioned into increments whose development is phased over the total development cycle.

[7]We did not independently verify this estimate.

remaining one-fourth relate to such capabilities as AWIPS' performance, security, availability, and flexibility. Figure 1 depicts this AWIPS hierarchy.

Figure 1: AWIPS Hierarchy



NWS Cannot Show That All AWIPS' Proposed Capabilities Are Related to Mission Improvements

Investments in information technology, like AWIPS, should be justified on the basis of whether or not all planned system capabilities will make a clear difference in advancing mission efficiency and effectiveness (for example, improved forecasts and warnings). NWS has not done this for AWIPS. According to NWS officials, they have not explicitly linked either AWIPS requirements or higher-level capabilities to mission improvements, and they have no plans to do so because they claim that other requirements reviews, analyses, and validation activities already provide implicit justification for all AWIPS' proposed capabilities. We disagree. We carefully reviewed these other activities and while we found them to be valuable for different reasons, they were neither intended to nor do they demonstrate that AWIPS' full array of capabilities will improve NWS mission effectiveness. As a result, NWS risks unnecessarily spending money on AWIPS capabilities that do not satisfy any of its mission improvement goals—better forecasts, fewer field offices, and fewer staff.

System Capabilities Should Be Validated to Mission Improvements

Office of Management and Budget (OMB) Circular A-130, Management of Federal Information Resources, requires agencies to create and maintain management and technical frameworks that define linkages between mission needs and information technology capabilities. OMB Circular A-109, "Major System Acquisitions," expands on A-130, requiring federal agencies to make system design decisions based on a review of proposed system functional and performance capabilities contributions to mission needs and program objectives. In effect, agencies developing computer systems, like AWIPS, are to show that proposed system capabilities will produce some mission effectiveness or efficiency gain, like more reliable and timely forecasts or office and staffing reductions.

These requirements are consistent with our recent findings on how leading public and private organizations tie technology investments to measurable mission improvements.[8] We found that successful organizations' information system investment decisions are tied to explicit and quantifiable mission improvements. By doing so, these organizations know that investing in system requirements will make a difference in mission outcomes.

Ensuring that proposed system capabilities are justified before expensive software development begins requires validating (that is, proving) that system requirements are anchored in user needs, which in turn are

[8]Executive Guide: Improving Mission Performance Through Strategic Information Management and Technology (GAO/AIMD-94-116, May 1994).

grounded in positive mission impacts. To do less increases the chances of spending money on capabilities that, even though desired by users, will not advance the organization's effectiveness or efficiency. Accordingly, software development guidance advocates assuring traceability from derived system requirements, designs, and implementations to both original user needs and mission needs.[9] Approaches to validating proposed capabilities include performance modeling and prototyping.

Despite Past and Ongoing Requirements Reviews, NWS Has Yet to Justify AWIPS' Capabilities on the Basis of Mission Results

According to NWS, planned AWIPS capabilities are necessary and will contribute to NWS' goals of weather forecast and warning improvements, field office consolidation, and staff reductions. However, NWS officials were unable to produce any analysis or associated documentation to validate this claim. Instead, they presented the results of past AWIPS requirements analysis and definition activities and discussed ongoing requirements validation activities that, while useful in their own right, do not justify AWIPS capabilities on the basis of mission improvements. Each of these requirements review activities are discussed below.

The first AWIPS requirements review began in 1984, when NWS initiated the Denver AWIPS Risk Reduction and Requirements Evaluation (DAR^{3}E) program, an extensive AWIPS prototyping effort to analyze and refine meteorology requirements. Later, NWS augmented the DAR^{3}E effort with an equally impressive prototyping effort addressing hydrology requirements, which NWS labeled the Prototype River Forecast Center Operational Test, Evaluation, and User Simulation (PROTEUS). Through these efforts, user observations, feedback, and suggestions concerning such things as data integration, access, animation, presentation, as well as workstation performance were obtained and used to revise AWIPS requirements and specifications.

Without question, these prototyping efforts effectively involved users in the process of refining requirements and contributed immensely to establishing a set of AWIPS requirements that reflected the wishes of NWS' forecasting community. However, AWIPS requirements and capabilities, as currently planned, extend beyond these prototypes. According to NWS officials, the DAR^{3}E prototype addressed roughly half of AWIPS' 22,000 requirements. The half that were addressed equates to over three-fourths of AWIPS' total lines of code. Moreover, even those AWIPS capabilities that were part of the prototypes, with one limited exception, were not

[9]Guidelines for Successful Acquisition and Management of Software Intensive Systems, Department of the Air Force, Software Technology Support Center, February 1995.

explicitly linked to measurable improvements in NWS' mission effectiveness during these prototyping activities. The one exception is an NWS analysis linking DAR²E to increased warning lead times, more specific warning locations, decreased warning durations, and reduced false alarms. However, this same analysis attributed the lion's share of the improvements to NEXRAD, which NWS officials also stated was the true reason for the improvements.

On the basis of early AWIPS prototyping and the efforts of the AWIPS Requirements Task Team, system requirements were again validated to user needs in 1985. According to AWIPS requirements traceability documents, the AWIPS System Requirements Specification was traced to user-generated AWIPS requirements, known as the user language specification, that resulted from the early prototyping and the task team's efforts. Again, this validation activity was valuable in ensuring that proposed AWIPS capabilities are anchored in user needs. However, it says nothing with respect to whether they are rooted in mission-based goals.

Another major review effort occurred in 1991 and 1992 when NWS performed what it calls the "AWIPS rebaselining." Briefly, this effort entailed prioritizing AWIPS' capabilities, and designating which capabilities needed to be developed first and which could be postponed to a later development phase. The rebaselining did not attempt to justify pursuit of these capabilities on the basis of contribution to mission performance gains.

Since 1991, follow-on DAR²E activities occurred at the Norman, Oklahoma, weather office to emulate the operations of a future, modernized weather office. According to NWS, the emulation examined such things as the AWIPS user interface for displaying NEXRAD products, AWIPS' integration of national weather products (e.g., satellite imagery) with local data (e.g., NEXRAD products), and future weather office staffing levels. However, we reviewed the results of these emulation activities and found no evidence validating AWIPS-specific capabilities on the basis of stated NWS mission goals of better forecasts, fewer weather offices, or less staff. For example, one report concluded that the AWIPS prototype provided capabilities for viewing NEXRAD data that forecasters found "useful," but does not show the mission outcome of having the capabilities. Another report that was AWIPS-specific concluded that a proposed AWIPS capability known as Interactive Computer Worded Forecast (ICWF), which is later to be replaced by the AWIPS Forecast Preparation System (AFPS), actually decreased rather than increased forecaster productivity and should not be deployed in its current form.

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In 1994, in response to the contractor's earlier mentioned failure to produce an AWIPS design, NWS undertook what it refers to as a "functional decomposition" of the 22,000 AWIPS requirements. In effect, NWS placed these requirements into about 450 capability categories. These categories are the foundation of the AWIPS "A-Spec," which, as mentioned earlier, is the high-level system specification that further combines most of the 450 capabilities into five broad functional areas. (See figure 1.) Clearly, the development of the "A-Spec" was a valuable undertaking in that it translated the 22,000 AWIPS requirements into a smaller, simpler, more understandable set of high-level functions. However, this translation did not, nor was it intended to, link requirements or capabilities to mission improvements.

Beginning in 1994 and continuing through today, NWS also has been reviewing all AWIPS requirements to identify any that are, in its words, "archaic," meaning that they are technologically obsolete, duplicative of other AWIPS requirements, or in need of modification to comply with AWIPS' system design. Thus far, NWS has reviewed about 900 of the 1,000 requirements it dubbed as potentially extraneous and chose to eliminate about 600. The remaining 100 still need to be evaluated. Again, this requirements "scrub" has been and continues to be worthwhile. However, NWS' above-cited criteria do not address whether the proposed requirement or capability will produce a measurable mission improvement.

At the same time NWS is completing its review of the aforementioned "archaic" requirements, the joint NWS/contractor teams established to develop AWIPS' application software are examining requirements one last time before building each software module. According to the AWIPS Software Development Plan, the required AWIPS scientific applications in many instances were written several years ago and may still contain ones that are obsolete. However, the NWS official responsible for overseeing the joint development teams stated that the teams' process for reviewing the requirements does not attempt to validate requirements back to mission improvements. Also, the official stated that the focus of the reviews is on reaching a common understanding on how best to proceed in developing the software module.

Conclusions

NWS clearly needs a new, modern system to support its current operations and allow it to take advantage of the vast data streams now available through its new observing systems. However, whether all of the 450 capabilities it plans for AWIPS are necessary to accomplish this is unknown

because the process it has followed in developing AWIPS, while providing for traceability between proposed system capabilities and user expressed needs, does not include validating that these capabilities explicitly and measurably advance NWS' mission efficiency and effectiveness, which NWS has defined in terms of improved forecasts, fewer field offices, and reduced staffing levels. Validating system capabilities to mission outcomes is vital because it confirms prior to costly software development that proposed system capabilities are grounded in and will contribute to NWS' mission goals. Unless NWS expands ongoing AWIPS requirements review activities to include demonstrating, either quantitatively or qualitatively, that proposed capabilities measurably advance NWS' mission abilities, it risks spending money to develop capabilities that are not justified.

Recommendations

We recommend that the Secretary of Commerce direct the NOAA Assistant Administrator for Weather Services to (1) expand ongoing AWIPS requirements review activities to include validation that proposed capabilities are justified on the basis of mission impact and (2) not implement any of those capabilities that are not validated. At a minimum, such validation should include analyses of data and factual accounts from past and ongoing AWIPS prototype experiences that link those proposed capabilities to stated mission improvement goals.

Agency Comments and Our Evaluation

On January 24, 1996, we discussed a draft of this report with NOAA and NWS officials, including the NOAA Associate Administrator for Weather Services, the Deputy Assistant Administrator for Operations, and the Deputy Assistant Administrator for Modernization. In general, these officials did not agree with the report's conclusions and recommendations, reiterating the NWS positions that were in our draft report. In particular, they stated that extensive AWIPS requirements validation activities have occurred and are ongoing. They also stated that only AWIPS capabilities that are essential to NWS' mission are being pursued, and that their inability to prove that mission-based requirements validation activities were performed is not sufficient to conclude that AWIPS is not needed. They promised to provide additional documentation to show that AWIPS proposed capabilities are grounded in mission impacts.

We agree that extensive validation activities have occurred and are still ongoing, and we give NWS credit for these activities in the report. Unfortunately, NWS' validation activities have only dealt with a part of the validation equation and have not validated AWIPS capabilities to its stated

mission outcomes of better forecasts, fewer field offices, and fewer staff. This is completely at odds with our recent findings on how leading public and private sector organizations base successful technology investments on whether they produce meaningful improvements in the cost, quality, and timeliness of product and service delivery.[10]

Further, we neither state nor imply that AWIPS is not needed. Rather, we are saying that NWS is spending hundreds of millions of dollars without knowing whether all AWIPS capabilities will contribute to its stated reasons for investing in the system (improving forecasts and reducing field offices and staffing levels). Restated, while we do not question the need to replace AFOS, we do question whether AWIPS, with all the capabilities that NWS currently envisions it providing, should be that replacement. Unless NWS addresses this question, it risks spending money for capabilities that do not advance its mission performance. Fortunately, NWS has the opportunity to perform this validation activity as part of already ongoing and planned requirements reviews. We strongly encourage NWS to take advantage of this opportunity.

We reviewed the additional documentation that NWS officials provided and have included it in the report as further evidence of NWS' thorough validation of AWIPS capabilities to user needs. However, this documentation does not show that AWIPS capabilities are anchored in mission improvements. We have incorporated other comments made by the officials in the report where appropriate.

[10]Executive Guide: Improving Mission Performance Through Strategic Information Management and Technology.

We are sending copies of this report to the Secretary of Commerce, the Director of the Office of Management and Budget, and interested congressional committees. Copies will also be made available to others upon request.

Please call me at (202) 512-6240 if you or your staff have any questions concerning this report. Other major contributors are listed in appendix III.

Sincerely yours,

Jack L. Brock, Jr.
Director, Information Resources
Management/Resources, Community, and
Economic Development

Contents

Abbreviations

AFPS	AWIPS Forecast Preparation System
AFOS	Automation of Field Operations and Services
ASOS	Automated Surface Observing System
AWIPS	Advanced Weather Interactive Processing System
DAR^{3}E	Denver AWIPS Risk Reduction and Requirements Evaluation
GOES-Next	Next Generation Geostationary Operational Environmental Satellites
ICWF	Interactive Computer Worded Forecast
NEXRAD	Next Generation Weather Radar
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
OMB	Office of Management and Budget
PRC	Planning Research Corporation
PROTEUS	Prototype River Forecast Center Operational Test, Evaluation, and User Simulation

Appendix I

Objective, Scope, and Methodology

The objective of our review was to determine whether NWS' process for developing AWIPS has demonstrated that all proposed system capabilities will contribute to promised modernization outcomes—improved forecasts, fewer weather offices, or reducing staffing levels. To determine this, we interviewed program officials and reviewed system development documentation to document past and ongoing steps to validate AWIPS requirements. In particular, we reviewed analyses of AWIPS' prototyping efforts, memoranda from the 1992 rebaselining of the AWIPS requirements, the System/Segment Specification for the National Weather Service Advanced Weather Interactive Processing System, and the Requirements Traceability Document for the AWIPS Hydrometeorological Computer Software Configuration Item. We also sought program officials explanations of how AWIPS requirements are tied to and will result in improved forecasts, weather office closings, and staff reductions.

Concerning ongoing AWIPS requirements reviews, we interviewed NWS staff currently reviewing AWIPS requirements to determine the purpose of the reviews and the criteria being used to assess the requirements. In addition, we interviewed the NWS official overseeing the NWS/contractor teams developing the AWIPS software modules to learn what validation steps and criteria the teams are employing.

We provided a draft of this report to the Department of Commerce for comment. On January 24, 1996, we obtained oral comments from NOAA and NWS officials. These comments have been incorporated in the report as appropriate.

We performed our work at the AWIPS program office, and at NOAA and NWS headquarters offices in Silver Spring, Maryland, from August 1995 through January 1996 in accordance with generally accepted government auditing standards.

Appendix II

Examples of AWIPS Capabilities by Functional Area

This appendix provides examples of AWIPS capabilities for each of the five functional areas.

Functional area	Examples of capabilities
Communications	— Acquire data automatically when permitted by the observation systems
	— Acquire data through external interfaces at the National Meteorological Center segment, including, polar orbiter data, lightning data, and NEXRAD base and derived products
	— Acquire data from network segment external interfaces, including formatted GOES-Next products, NEXRAD summary and winds data, surface and upper air observations, and data from GOES-Next data collection platforms
	— Distribute data among AWIPS sites.
	— Request data (excluding NEXRAD products and satellite imagery) from another AWIPS site.
	— Specify the distribution control parameters, including data destinations, data to be distributed, data prioritization, and destinations required to acknowledge receipt of a high-priority product
	— Disseminate data when requested by an external user
	— Disseminate hazardous weather products designated by the user to external users automatically

(continued)

Functional area	Examples of capabilities
Monitor and control	— Provide NWS with dedicated, electronic access to the network control facility — Monitor the integrity and timeliness of data and products that are acquired or disseminated over a central interface. — Notify users when degradations and malfunctions of site equipment and communications interfaces are determined — Provide an orderly shutdown upon detection of a system failure. — Control the display of information on workstations at other AWIPS sites — Provide the capability for users to remotely install software at another site — Provide an interactive, graphical method to allow the user to define two unique alert areas for monitoring NEXRAD data

(continued)

Functional area	Examples of capabilities
Processing	— Spatially transform a point and grid of points from one map projection, coordinate system, and grid definition to another by interpolation
	— Execute one-dimensional numerical cloud models for forecasting cloud top heights, vertical velocity, and hail sizes
	— Execute a numerical model to forecast icing potential for aircraft.
	— Execute a simplified dam break channel flow model
	— Compute tide and water level heights and departures.
	— Compute extraterrestrial radiation parameters.
	— Generate combined reflectivity/velocity products from NEXRAD data
	— Produce three-dimensional image perspective displays.
	— Perform image inversions, on a pixel-by-pixel[a] basis.
	— Perform image-sharpening and edge-enhancement on images.
	— Display the hydrometeorological field on cross-section and time-section plots using contours, plotted values, and wind symbols
	— Produce graphical pilot weather briefing displays, including the depiction of the current and forecast conditions along the flight route plotted on a cross-section context background
Display and interaction	— Simultaneously display up to at least eight data windows on each workstation monitor
	— Toggle between the components of a combined image
	— Zoom in and out on displayed image and graphics products with zoom ratios up to 8:1
	— Generate color slides, prints, and transparencies of displayed data
	— Step frame-by-frame through an animation loop
	— Edit elements of a displayed graphic and its attributes on a workstation image/graphics monitor.

(continued)

Functional area	Examples of capabilities
Data management	— Retrieve data stored locally
	— Specify retrieval criteria, such as all temperatures above a certain threshold value
	— Store and retrieve hydrometeorological (for example, satellite data, observational data), cartographic (for example, geopolitical boundaries, topography), site management (for example, region information, maintenance activities), and event data (for example, systems errors, performance parameters)
	— Archive data at the network segment and all site segments

[a]Pixels, also known as picture elements, are the tiny dots that collectively form a grid on a computer screen and that when turned on in specific patterns form characters or drawings

Appendix III

Major Contributors to This Report

Accounting and Information Management Division, Washington, D.C.	Rona B. Stillman, Chief Scientist for Computers and Communications Randolph C. Hite, Assistant Director Keith A. Rhodes, Technical Assistant Director David A. Powner, Evaluator-in-Charge Robert C. Reining, Information Systems Analyst Colleen M. Phillips, Information Systems Analyst

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NWS Response to the GAO Report titled *Weather Forecasting: NWS Has Not Demonstrated That New Processing System Will Improve Mission Effectiveness*, dated February 1996.

COMMENTS:

The goals of the NWS modernization are predicated on integrating modern technologies, scientific advances, and trained personnel to provide improved weather services in a cost effective manner. Modernized operations will be quite complex with many linkages between staffing resources and system capabilities and numerous interdependencies among systems. Thus, it is difficult to attribute specific improvements in forecast accuracy, for example, provided by the modernization to a particular system capability, new scientific technique, or increased level of forecaster proficiency.

The GAO report correctly recognizes that AWIPS is central to modernized operations. AWIPS is essential to realize the full benefit of the investments made in the NWS Modernization to date. For example, the new series of GOES satellites has shown a great potential for the early identification of fog formation. Fog has a huge impact on the aviation industry (and other users, as well) . However, to provide an improved service to the user -- a timely and detailed forecast of the areas expected to be impacted by fog -- system capabilities beyond GOES are essential. These include AWIPS communications to transmit the GOES data to the local office in near-real time; display software to enhance the relevant features and combine the image with local data sets, including detailed map backgrounds; message composition software to allow product generation; and dissemination capabilities to allow the timely receipt of the product by the end user. To effectively use these new tools, the forecaster must have received the necessary training to recognize and forecast the event. While this example focuses on GOES capabilities, similar examples could be provided with respect to new data streams available from NEXRAD, ASOS, and the advanced numerical weather prediction models run on the Class VII computers.

The NWS continually examines planned modernized operations to validate anticipated operational procedures, refine and test proposed system capabilities, gain insight into required staff resources, and assess service impacts. These assessments have employed prototypes of system capabilities used in an operational setting that simulates the modernized era (e.g., trained personnel, reconfigured service area, etc.). While expensive and time consuming, these activities have yielded valuable information to shape modernized operations. The GAO report highlights the major activities in this area; however, it finds them lacking because they don't attribute specific improvements to a specific system or system capability. The DAR^{3}E prototype experience did show increased warning lead times, more specific warning locations, decreased warning durations and reduced false alarms. There is no doubt that the capability of the NEXRAD radar was essential to these improvements. However, the AWIPS-like capabilities that provided rapid display and animation of images and data, overlay of NEXRAD data with other

data sets, warning generation software, and rapid dissemination of the warning all contributed to the improved service. Because of the complex, integrated nature of modernized operations, it is virtually impossible to shred the service improvement down to the system capability level.

The NWS will continue risk reduction activities to validate the AWIPS capabilities planned for future system releases. Weather Forecast Office Advanced (WFO Advanced) is a prototype system that contains most of the AWIPS capabilities planned for the fourth system release and employs the AWIPS target hardware and commercial software, where possible. It will be deployed in operational settings at the Denver and Norman forecast offices for a risk reduction activity prior to and after Key Decision Point IV. This risk reduction activity will provide feedback to AWIPS development and will help validate planned AWIPS capabilities.

In addition, NWS will conduct an operational test and evaluation of AWIPS, for each build. This activity is aimed at demonstrating the operational capabilities of the system and to establish confidence that the system will achieve its operational objectives. The results of the OT&E activities will provide valuable input to ongoing and future development of AWIPS capabilities. The NWS has no interest and inadequate resources to develop and deploy capabilities that are not necessary to carry out its mission, to restructure, and to downsize.

The GAO report suggests that all system capabilities must be tied to and validated by specific mission improvements. The NWS has validated the AWIPS system against mission needs. Individual system capabilities have been validated against the modernized WFO operations planned. In general, the NWS is confident that planned AWIPS capabilities will support the three goals listed in the GAO report (i.e., better forecasts, fewer weather offices, and lower staffing levels). However, many specific AWIPS capabilities are designed to meet basic infrastructure requirements (e.g., communication of data) that support the provision of weather services. These capabilities will not necessarily lead to specific mission "improvements", but are clearly vital to core of operations and the replacement of current systems which are obsolete and inadequate. The justification and validation for the totality of AWIPS requirements are derived from the day-to-day operations of the NWS.

RECOMMENDATION:

(1) Expand ongoing AWIPS requirements review activities to include validation that proposed capabilities are justified on the basis of mission impact, and (2) not implement any of those capabilities that are not validated. At a minimum, such validation should include analyses of data and factual accounts from past and ongoing AWIPS prototype experiences that link proposed capabilities to stated missing goals.

The NWS disagrees with this recommendation. The best, and often only, method for validating the proposed capabilities is to continue with planned risk reduction activities and the operational test and evaluation of each system build. Both these activities will provide vital information back into the development process so we can be assured that the system capabilities

are validated. This process will ensure that capabilities that are not needed will be revised or not implemented.

We believe that expending the additional time and resources required to validate all capabilities on the basis of mission impact in advance of incremental deployment is not an efficient or cost-effective process. If implemented, the recommended actions would cause further delay and expense to the program and yield no significant reduction in program risk. The current risk that resources will be devoted to developing, testing and deploying unnecessary capabilities is negligible. The risk that NWS will not be able to maintain operations with archaic systems without AWIPS is high. The inability of NWS to capitalize on powerful new information services already available from the modernization without AWIPS is certain. We are confident that the requirements reviews and risk reduction activities mentioned in the GAO report and ongoing risk reduction and OT&E activities are sufficient to validate AWIPS capabilities.

Detailed Comments

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4. Full AWIPS deployment is scheduled to begin in 1997, not 1999 as stated on page 4. The deployment should be completed in two years, if sufficient funding is available. The production contract is being structured to allow stretch out of deployment over three years if necessary, but with added costs and attendant delay in providing modernized capabilities to some parts of the nation.

5. The set of requirements developed for AWIPS reflect the needs, not the "wishes" of the NWS forecasting community (page 7). These needs are based on systematic assessment of what functional capabilities are required to carry out NWS missions in the modernized environment with fewer restructured offices and modernized data sources. The capabilities that drive system complexity and cost have been prototyped and validated or critiqued by field forecasters based on actual use. To further reduce risk and ensure mission effectiveness, the capabilities will be deployed and verified in manageable increments.

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U.S. DEPARTMENT OF COMMERCE
Office of Inspector General

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NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Management and Engineering Problems Halt AWIPS Progress

Inspection Report No. OSE-6623-4-0001 / September 1994

Office of Systems Evaluation

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OFFICE OF INSPECTOR GENERAL
FINAL INSPECTION REPORT
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
MANAGEMENT AND ENGINEERING PROBLEMS HALT AWIPS PROGRESS

EXECUTIVE SUMMARY

The Advanced Weather Interactive Processing System is being developed to replace the antiquated Automation of Field Operations and Services System, which processes meteorological data and distributes it to National Weather Service field offices and other facilities. AWIPS is intended to provide forecasters with modern interactive processing and display capabilities and to enable them to acquire data from the advanced observing systems currently coming on-line. It is estimated that AWIPS will cost nearly $500 million. AWIPS is the key integrating element of the National Weather Service's $4 billion modernization program and essential to achieving weather service operational improvements and resultant cost savings. Thus, it is of the highest priority.

The Systems Program Office was created in 1991 to manage NOAA's major systems acquisitions because the systems of the weather service modernization were over cost, behind schedule, and unable to meet their technical specifications. The SPO was designed to report at the NOAA Deputy Under Secretary level and be independent of operational and budget transfer vulnerabilities. It was separated from weather service management to ensure that acquisitions would meet their cost, schedule, and technical goals. Before 1991, the AWIPS Program Office was a component of the weather service; it now resides in the SPO. NOAA has recently undertaken a reorganization in which the SPO's responsibility for acquiring major systems has been reduced. Although the reorganization is not yet official, NOAA is operating informally under the new organization.

AWIPS is being acquired in four phases—Requirements, Definition, Development, and Deployment. Computer Sciences Corporation and PRC Inc. competed in the AWIPS Definition Phase from 1988-1992. The government awarded the Development Phase contract to PRC in December 1992. Soon after contract award, the weather service and the program office realized that PRC did not fully understand the AWIPS requirements and that there was a high risk the proposed design would not provide the intended capabilities and performance. In an attempt to correct these problems, the program office negotiated a major contract amendment, which included a requirement for PRC to provide a System Design Document. In February 1994, PRC submitted the design document, which was rejected by the program office.

We conducted this inspection to determine the technical, management, organizational, and contractual issues associated with the AWIPS acquisition. Our major conclusions are as follows:

- **AWIPS lacks a reliable technical foundation for system development.** The weather service's acquisition strategy was flawed because it did not require the contractors to develop and document system designs for AWIPS during in the Definition Phase, where the government could examine them in detail in discussions with the competing contractors. Instead, designs were required in the Development Phase proposals and evaluated during source selection. In the restricted source selection environment, their accuracy and integrity could not be definitively determined. The government identified serious deficiencies after contract award, particularly in the software design, and added a contract requirement to provide a documented system design. However, PRC delivered an inadequate System Design Document, which the government rejected. A complete and correct system design is needed for accurate project costing and scheduling, directing the development work, and early problem identification. The lack of an acceptable system design entering the Development Phase, combined with the lack of technical progress, invalidates the AWIPS cost and schedule baseline, making overruns inevitable. (See page 4.)

- **An unrealistic schedule and inadequate systems engineering have halted AWIPS progress.** During the Definition Phase, with the project already behind schedule, the SPO and weather service realized that the planned Development Phase schedule was unrealistic, and it was revised. Although the Development Phase was extended by 15 months, the new schedule was still overly aggressive. Nonetheless, weather service and SPO management believed that AWIPS could be expedited through a schedule acceleration incentive and provided up to $7.5 million for up to six months of acceleration in the Development Phase contract. It appears that the aggressive schedule, combined with the acceleration incentive, has contributed to the inadequacy of the System Design Document and a poor relationship between the contractor and the government. We believe the schedule acceleration incentive, until recently, has made PRC resistant to changing the System Design Document and thus has inhibited progress in developing a corrective action plan. (See page 7.)

- **The SPO lacks authority to acquire AWIPS.** The draft Department Organization Order revising NOAA's organization sets forth an acquisition management structure that fails to give either the SPO or the line offices clear responsibility, authority, and accountability for managing major systems acquisitions. It does, however, give the line offices oversight over the SPO, thereby making the SPO subordinate to them. In practice, the SPO's authority and responsibility for acquiring systems and control over its budget have returned to the weather service. The weather service believes it has the authority to approve all major acquisition decisions, giving it undue control over the program office. The weather service has redirected AWIPS acquisition funds to other activities, including activities that were disallowed in the Department's and OMB's budget decisions. Thus, the program office cannot rely on receiving or retaining funding consistent with the decisions of the Congress, OMB, or the Department. We recognize that NOAA's reorganization of major systems acquisition responsibilities was intended to correct the

management deficiencies that existed in the SPO and the AWIPS Program Office. However, the new organization has led to a serious decline in the SPO's ability to manage. NOAA needs to improve SPO management and technical capabilities, not abandon the SPO concept. (See page 10.)

Our recommendations begin on page 14.

NOAA's Response and OIG Discussion

NOAA agreed in its response to our draft report that the management and engineering problems we identified both in this draft and in our May 1992 inspection report, *AWIPS Re-baselining and Associated Issues*, have halted AWIPS progress. Although NOAA states that it is committed to solving each management and engineering problem, it has not set up a management structure capable of doing so. Specifically, NOAA says that it has not returned control of the AWIPS acquisition to the weather service. NOAA further says that it strongly endorses the continued importance of the SPO and is providing it the full range of needed authority. However, the facts do not bear this out.

In practice, the weather service now controls AWIPS. Our review of the current approach on AWIPS shows that the weather service has chosen to manage and design AWIPS through a hierarchy of committees comprising itself, the SPO, and the contractor. This approach has led to an ambiguous and illogical division of responsibilities, which cannot be expected to obtain AWIPS within any reasonable cost or schedule and has made it impossible to hold any organization accountable for results. It also blurs the distinction between the contractor's and the government's responsibilities. The weather service contends that its unusual level of involvement with the contractor is necessary because only the weather service has the scientific (i.e., meteorological and hydrometeorological) knowledge needed to design and develop AWIPS. While comprehensive scientific knowledge is essential input for developing the scientific applications software, we do not believe it is necessary for developing the system design. Moreover, the weather service has also decided that it and other NOAA entities will develop all of the scientific applications software, leaving development of the so-called "infrastructure" software, which requires only minimal scientific knowledge, to the contractor. Therefore, we do not believe that the weather service's justification for its committee-based approach is valid.

Furthermore, AWIPS continues to be schedule driven. Although unrealistic schedules have been a major cause of failure on this program in the past, NOAA is rushing an early capability, called "Pathfinder," to the field. The Pathfinder will provide only a limited amount of software that is directly transferable to AWIPS, is being developed on a schedule that is likely to compromise the quality of that software, will not incorporate the AWIPS internal software architecture, and will not employ the AWIPS user interface. Thus, the Pathfinder will divert essential resources and management attention from the important task of building AWIPS.

NOAA indicates that it is using its draft Department Organizational Order (DOO) 25-5, *National Oceanic and Atmospheric Administration*, which describes its proposed reorganization and draft NOAA Administrative Order (NAO), *Major System Acquisitions*, to delineate functions and define roles and responsibilities. However, our review shows that the directives define these responsibilities in a confused, inconsistent, and ambiguous fashion, undermining the intended and critical role of the SPO.

The SPO was created because of NOAA's demonstrated inability to manage the development and acquisition of major systems. It was modeled after organizations that have successfully acquired major systems in the federal government and developed them in the private sector. However, NOAA's unofficial reorganization, as represented in the DOO, NAO, and its current operations, are divesting the SPO of these attributes while not establishing a corresponding structure in NOAA having these important features.

The current problems with AWIPS are the legacy of the weather service's previous management history. The weather service lacks personnel with the experience and expertise to manage the development and acquisition of major systems. As a result, it has been unwilling to apply the well-known principles and disciplines developed by industry and government for managing large, complex, one-of-a-kind systems. We are encouraged, therefore, that the weather service is now beginning to show interest in adopting management approaches we have been advocating for years—and which it previously rejected as burdensome and unnecessary—for arriving at the AWIPS system design and proceeding with development. These approaches include assembling a tractable set of requirements, adopting a defined and proven engineering process, and identifying an initial operating capability that is actually the minimum necessary to proceed with restructuring and the Modernization and Associated Restructuring Demonstration. However, given the lack of a disciplined management organization, it is not likely that AWIPS can be produced within a reasonable cost or timeframe.

Furthermore, given the current organization, the SPO will remain ineffectual and its ability to recruit, retain, and effectively use capable managers and technical personnel will be severely limited. Although the SPO recently assigned an AWIPS program manager with both extensive management experience and a successful track record in acquiring systems like AWIPS, he resigned after only a short time on the job, recognizing that the organization is not tenable. Returning AWIPS to the SPO will no longer be sufficient. The SPO *must* be permitted to do the job it was established to do and staffed with the capability to do so. NOAA's current course on AWIPS is expensive and nonresponsive to the management issues.

Because NOAA raised objections to a number of our findings and made changes to the program since our draft report, we have presented a synopsis of its response in the body of our report and have added a discussion of the issues raised or changes that have been made. Our analysis of the draft Department and NOAA orders is presented in the appendix. A copy of the complete NOAA response is included as an attachment to this report. We reaffirm our findings and recommendations.

INTRODUCTION

The Advanced Weather Interactive Processing System is being developed to replace the antiquated Automation of Field Operations and Services System, which processes meteorological data and distributes it to National Weather Service field offices and other facilities. AWIPS is intended to provide forecasters with modern interactive processing and display capabilities. It will provide the capability to acquire data from the advanced observing systems currently coming on-line, including the new Doppler weather radars, the next generation of Geostationary Operational Environmental Satellites, and the Automated Surface Observing System. AWIPS will provide forecasters with tools to rapidly analyze the data, integrate it with the information provided by the weather service guidance centers, and prepare timely and accurate warnings and forecasts for dissemination to the public and the media. It is estimated that AWIPS will cost nearly $500 million. AWIPS is the key integrating element of the National Weather Service's $4 billion modernization program and essential to achieving weather service operational improvements and resultant cost savings. Thus, it is of the highest priority.

BACKGROUND

Systems Program Office

The Systems Program Office was created in 1991 to manage NOAA's major systems acquisitions because the systems of the weather service modernization were over cost, behind schedule, and unable to meet their technical specifications. The SPO was designed to report at the NOAA Deputy Under Secretary level and be independent of operational and budget transfer vulnerabilities. It was separated from weather service management to ensure that acquisitions would meet their cost, schedule, and technical goals. Before 1991, the AWIPS Program Office was a component of the weather service; it now resides in the SPO.

NOAA has recently undertaken a reorganization that has significantly increased the weather service's responsibility for acquiring major systems and correspondingly decreased the SPO's responsibilities. NOAA's revised Department Organization Order, which will formalize the reorganization, is still in draft. However, NOAA is operating informally under the new organization.

AWIPS

AWIPS is being acquired in four phases. In the Requirements Phase (October 1984-September 1988), the weather service identified the mission need for AWIPS and defined requirements. In the Definition Phase (September 1988-November 1992), Computer Sciences Corporation and PRC Inc. were selected to develop competing system design concepts and perform risk reduction activities. PRC was selected for the Development Phase, which comprises full-scale development and limited production and deployment. The Development Phase contract was awarded in

December 1992 and is scheduled to extend through February 1996. In the Deployment Phase, planned for February 1996-February 1998, production and deployment will be completed.

We conducted an earlier inspection of AWIPS during the Definition Phase, soon after the SPO had assumed responsibility for the acquisition. We found that the Development Phase solicitation, which had been prepared by the weather service, was incomplete, disorganized, and ambiguous. We concluded that the solicitation (1) would lead to a contract that would be difficult to administer and to disputes that would be difficult to resolve, (2) would not form the basis for an enforceable contract, and (3) did not provide for a coherent engineering process. We recommended that the SPO's AWIPS Program Office thoroughly review and revise the solicitation prior to contract negotiations with the objective of obtaining a clear, complete, consistent, and enforceable contract. The program office failed to implement our recommendations, stating that the schedule would permit no further delays.[1]

In response to our specific concern that key requirements for disciplined engineering processes were missing from the statement of work, AWIPS officials stated that the offerors' plans and proposals comprise those requirements and would be contractually binding for the winner upon contract award. They added that although the solicitation may have deficiencies, the contractors have been working with the weather service for many years, and they know what the agency wants. We were also concerned that the Development Phase contract required an overly aggressive 39-month schedule and inappropriately offered an incentive of up to $7.5 million for up to six months of schedule acceleration. In response to our concerns about these approaches, SPO senior officials stated that they would solve any problems through their management expertise.

Two months after contract award, the weather service and program office realized that PRC did not fully understand the AWIPS requirements and that there was a high risk its proposed design would not provide the intended capabilities and performance. The program office also believed PRC was not using disciplined engineering processes. In an attempt to correct these problems, the program office negotiated a major contract amendment. The amendment introduced requirements reviews, a System Design Document, and a system design review, and modified the preliminary design approach.

In February 1994, PRC submitted its AWIPS System Design Document, which the program office rejected as noncompliant and inadequate as a basis for further design and development. The program office and PRC have been holding discussions to determine how to correct the document. Since the time the document was rejected, both the SPO and PRC have assigned new program managers.

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[1] *AWIPS Re-baselining and Associated Issues,* U.S. Department of Commerce, Office of Inspector General, Systems Evaluation Division, SED-4585-2-0001, May 1992.

Synopsis of NOAA's Comments

NOAA disagreed that the Development Phase solicitation was incomplete, disorganized, and ambiguous and cited a review performed by Dr. Joseph F. Shea, Adjunct Professor with the Massachusetts Institute of Technology. In his review he noted that NOAA should complete the edits to the solicitation that the draft AWIPS Inspection Report had recommended. He also stated, "In summary, the AWIPS procurement, as presently structured, is well planned, and rigorously specified."

OIG Discussion

Dr. Shea's comments, presented in a March 30, 1992 letter to the Deputy Under Secretary for Oceans and Atmosphere, were based on two misunderstandings. The first was that we were recommending only that the solicitation be edited and that the edits be to nontechnical sections. In fact, our inspection report had recommended a thorough review of the entire solicitation with revisions to any part necessary This recommendation was based on our concerns about both technical and nontechnical deficiencies. The second misunderstanding was that the contractor's software task on AWIPS would be a fairly simple and low-risk matter, primarily involving the integration of commercially available "utility" software with already-developed NOAA software. In fact, the contractor's task requires careful up-front design work and a significant amount of new software development.

The lack of progress in the Development Phase demonstrates that the AWIPS procurement was neither well planned nor rigorously specified. Our May 1992 inspection report described numerous serious issues regarding the AWIPS solicitation. Many of the severe problems and excessive costs that NOAA is now facing are clearly attributable to the lack of rigor, discipline, and accuracy of the Development Phase solicitation and to the weather service's flawed acquisition strategy.

PURPOSE AND SCOPE

The objectives of this inspection were to: (1) determine the major deficiencies of the System Design Document, (2) assess whether the AWIPS Program Office and the contractor are establishing a reasonable approach to arriving at a system design and have adequate contractual and organizational mechanisms to perform the balance of the Development Phase work, (3) identify contractual issues that may be contributing to the lack of technical progress, and (4) determine whether the roles and relationships of the SPO and weather service are contributing to the problems.

This report is based on meetings with management and technical personnel from the AWIPS Program Office, the National Weather Service, and PRC, as well as SPO and PRC contracting

personnel. We reviewed the System Design Document, the AWIPS contract, correspondence between the AWIPS Program Office and PRC, and minutes of meetings held by the program office and PRC. Finally, we attended meetings in which the government and PRC discussed approaches to correcting the System Design Document.

NOAA's Department Organization Order would change the name of the SPO to the Systems Acquisition Office. The AWIPS Program Manager would become the AWIPS Acquisition Manager, and the weather service would designate its own AWIPS Program Manager. Although the reorganization has not formally occurred, NOAA officials have adopted this nomenclature. In this report, however, we refer to the NOAA organizations and personnel by their current official titles. That is, we refer to the Systems Program Office, as opposed to Systems Acquisition Office. The AWIPS Program Manager, AWIPS Program Office, and program office refer to the program manager and AWIPS Program Office in the SPO.

Inspections are special reviews that the Office of Inspector General conducts to give agency managers information about operations, including assessments of current and foreseeable problems. The objective is to promote effective, efficient, and economical management and to detect fraud, waste, and abuse. Our work was performed in accordance with the *Standards for Inspections* issued by the President's Council on Integrity and Efficiency.

OBSERVATIONS AND CONCLUSIONS

I. AWIPS lacks a reliable technical foundation for system development

The purpose of the Definition Phase in major systems acquisitions is to perform requirements analysis and systems engineering work in order to define the overall system architecture and design. This information is presented in a system design document, which serves as the technical and management basis for the development and production of the system. The system design is presented at a system design review, which allows the government to examine the design in detail in discussions with the competing contractors.

The documented designs and system design reviews (1) permit the government to determine whether the design provides the necessary technical and management basis for proceeding with full-scale development, (2) furnish critical information for selecting the contractor to do so, and (3) provide the information needed to estimate project cost and schedule with a reasonable degree of confidence. However, in the AWIPS Definition Phase, the weather service did not explicitly require the contractors to perform any systems analysis or systems engineering and did not require the development of a complete system design or delivery of a system design document.

Instead of obtaining documented system designs during the Definition Phase, the weather service required each contractor to submit a detailed design as part of its Development Phase proposal. However, in the source selection environment, where interaction with the offerors is strictly

limited, it was impossible for the government to determine whether the designs were arrived at using a disciplined engineering process and whether they were complete, consistent, and correct. The government therefore selected a system design whose accuracy and integrity could not be definitively determined at the time of contract award. Thus, the program office and weather service entered into the AWIPS Development Phase prematurely, without demonstrating that sufficient systems engineering work had been accomplished and without the necessary technical basis for their cost and schedule estimates.

The program office and weather service became concerned about the adequacy of PRC's system design soon after contract award. Because of the design deficiencies, as well as PRC's handling of the system requirements, the program office also believed that PRC was not using rigorous and systematic engineering processes. Accordingly, Modification 0005 to the AWIPS contract was negotiated, which introduced systems engineering tasks, the System Design Document, and a system design review.

The purpose of the AWIPS System Design Document was to present the high-level system architecture along with elements of the next design level—preliminary design. Although including preliminary design in a system design document is unconventional, the program office believed PRC had completed a great deal of preliminary design work for its Development Phase proposal. A lower level of detail was also necessary because PRC intended to use a concurrent development approach in order to accelerate the schedule. Under such an approach, three software builds (i.e., collections of software components) would be designed and developed in parallel; after the system design review, the government would have no further ability to assess the system design until an initial operating capability was completed, more than three years after contract award. If errors, omissions, or inconsistencies are present in the system design, there is a high risk that the software developed in the concurrent builds will not work together properly. If this occurs, substantial time and money will be wasted, and the work will have to be redone. Thus, the ability to examine the complete system design in considerable detail is of the utmost importance.

In rejecting the System Design Document, the program office noted that its concerns were so fundamental and significant that the system design review would be postponed. The program office convened an independent team to review the document. The team comprised representatives of MIT Lincoln Laboratory, The MITRE Corporation, the SPO Systems Engineering Office, and the National Weather Service Office of System Operations. PRC convened its own corporate review team from outside its AWIPS program office. Both teams agreed that the System Design Document was deficient, primarily in the software design.

The two review teams disagreed on the severity of the deficiencies, however. PRC concluded that modest corrective action would be needed and that the document posed a low risk to proceeding with AWIPS development. The government's review team, in agreement with the AWIPS Program Office, concluded that substantial effort would be needed to correct the document and that the document posed a significant risk.

Our review of the System Design Document confirms that the government's rejection was appropriate and that the design poses a significant risk. We found that the document presents an artificial structure bearing no relationship to how the software will be implemented. Even when developed to the detailed level, the design will provide neither the government nor PRC with the ability to assess whether it will meet AWIPS functional and performance requirements.

Because a complete and correct system design is needed for accurate project costing and scheduling, as well as for directing the development work, the lack of an acceptable system design entering the Development Phase, combined with the lack of technical progress, invalidates the cost and schedule baseline, making overruns inevitable. The current contract cannot be performed and needs to be substantially revised after an acceptable System Design Document is produced.

During our interviews, some senior weather service officials expressed the opinion that the program office is overemphasizing the system design and its documentation, pointing out that the government will not know if AWIPS will work adequately until functioning software is delivered. We strongly disagree. We believe the program office's attention to the system design is appropriate and essential. PRC must define the complete system design to ensure that the required functional capabilities are accounted for and the required performance is planned. Since system design errors propagate through all subsequent design and development, they are the most costly to correct. Although not all errors, omissions, and issues can be detected in a system design document and system design review, these are important mechanisms that prevent problems that result in significant schedule delays and expensive rework.

A documented system design does not represent a government paperwork burden being imposed on the contractor; rather, on a large, complex system such as AWIPS, it should be the routine by-product of a sound engineering process. PRC developed a substantial amount of functioning software for the weather service in the Definition Phase. However, this software could not confirm the AWIPS design in the absence of a complete and assessable system design document. Attempting to continue without a documented system design will perpetuate the problems that are stalling progress.

Requiring a documented system design does not preclude developing software, on a prototype basis, to resolve requirements, design, and implementation risks and issues. Prototyping should be part of an overall AWIPS risk management program, which would include identifying all major risks, estimating their impacts, determining which can be resolved through prototyping, and developing a plan and schedule for doing so. For AWIPS reliability, maintainability, and performance, it is essential that planning for software prototyping include a means for ensuring that prototypes are brought to production quality before they become an official part of the AWIPS system.

Synopsis of NOAA's Comments

NOAA agreed that the current System Design Document is inadequate and indicated that it is taking actions to obtain a complete and reliable design. These actions are to direct PRC to add appropriate technical staff, to adopt a documented, proven development process for AWIPS, and to implement a series of steps to lead to an acceptable system design. According to NOAA, the latter is being accomplished with strong government participation.

OIG Discussion

The efforts by NOAA and PRC to upgrade the contractor's technical capabilities are positive. Adopting a defined and proven development process is essential. However, although NOAA has tasked PRC to adopt such a process, it has chosen to design AWIPS by a hierarchy of committees comprising the weather service, the SPO, and the contractor. This is not a proven process. Moreover, this approach has led to an ambiguous and illogical division of responsibilities, which cannot be expected to obtain AWIPS within any reasonable cost or schedule and has made it impossible to hold any organization accountable for results. It also blurs the distinction between the contractor's and the government's responsibilities. The weather service contends that its unusual level of involvement with the contractor is necessary because only the weather service has the scientific (i.e., meteorological and hydrometeorological) knowledge needed to design and develop AWIPS. While comprehensive scientific knowledge is essential input for developing the scientific applications software, we do not believe it is necessary for developing the system design. Moreover, the weather service has also decided that it and other NOAA entities will develop all of the scientific applications software, leaving development of the so-called "infrastructure" software, which requires only minimal scientific knowledge, to the contractor. Therefore, we do not believe that the weather service's justification for its committee-based approach is valid. Finally, the system design is proceeding before PRC has completed its task of defining a proven process. Thus, it will be of limited use to the system design process, one of the most critical and difficult processes in systems development.

II. An unrealistic schedule and inadequate systems engineering have halted AWIPS progress

A. Inordinate Schedule Pressure

The original baseline schedule for AWIPS called for a two-year Development Phase and a four-year Deployment Phase. However, the competing contractors' system designs, as presented in their proposals, were less mature and the remaining software development work more extensive than the weather service had anticipated. Consequently, in October 1991, the SPO initiated an effort, in conjunction with the weather service, to re-baseline the program—that is, to revise the technical requirements and schedule.

During re-baselining, the weather service concluded that all of its previously planned functional requirements were still needed and focused on how to reschedule the software development. The new schedule extended the Development Phase to 39 months and reduced the Deployment Phase to two years. The Development Phase was divided into three software builds to yield an Initial Deployment Baseline. The first and second builds together are designed to provide basic system capabilities. The third build will provide additional hydrometeorological functions. The Initial Deployment Baseline will be installed at 16 sites and used for operational test and evaluation before deciding whether to proceed to the Deployment Phase. Additional capabilities are to be incorporated in two increments during the Deployment Phase. These increments are called pre-planned product improvements (P^3I). The second P^3I is to provide the capabilities needed for weather service staffing reductions.

Re-baselining took place in a schedule-driven environment. Because the program was already several years behind schedule when re-baselining was performed, the resulting 39-month development schedule was unrealistic, in our opinion. The Definition Phase contract had been awarded in September 1988 and was to have been completed in September 1990. At the start of re-baselining, the Definition Phase schedule had already been overrun by a year, and the SPO did not anticipate awarding the Development Phase contract for at least another year.

The extension to the Development Phase was substantial: Whereas the previous schedule had called for a tested initial operating capability 18 months after contract award, the re-baselined schedule would not produce an initial capability for over three years. Weather service and SPO management believed that AWIPS could be expedited through a schedule acceleration incentive. Accordingly, an incentive providing up to $7.5 million for up to six months of schedule acceleration was added to the Development Phase contract. PRC can therefore earn $7.5 million if AWIPS is delivered within 33 months without excessive cost growth. Through the award fee provisions, PRC can earn a maximum of $1.3 million for quality and other non-schedule factors. Thus, the schedule incentive completely overshadows the award fee incentive.

The aggressive schedule and acceleration incentive caused PRC to place an extraordinary focus on schedule, as the government intended. Based on our continuing reviews of the AWIPS Development Phase, we believe that PRC had a weak engineering process to begin with. The weak process combined with inordinate schedule pressure led to a deterioration in the performance of its engineering organization. Modification 0005 added requirements designed to improve the quality of the engineering work and would require several months to accomplish. Generally, a contractor would need a schedule extension to accommodate additional work of this nature, and PRC requested one. Because the acquisition was so intensely focused on schedule, however, no extension was granted, placing yet more schedule pressure on the program. In response, PRC planned more concurrent development and highly compressed its engineering activities in order to meet the 39-month schedule.

It appears that the aggressive schedule, combined with the schedule acceleration incentive, has contributed to a breakdown of discipline, organization, and focus in PRC's AWIPS effort; a poor

relationship between the contractor and government; and the failure of the System Design Document. We also believe the schedule acceleration incentive, until recently, has made PRC resistant to changing the System Design Document and thus has impeded progress in developing a corrective action plan.

Synopsis of NOAA's Comments

NOAA agreed with this finding and stated that it is currently undertaking a restructuring of AWIPS in which it is evaluating the total development effort, including schedule and incentives structure. As discussed below, we have concerns about NOAA's restructuring approach.

OIG Discussion

Although NOAA's restructuring plan has not been completed, it tentatively includes a reduction in the capabilities that will be fielded initially. The reduced capability will be selected to permit initial system operations, while minimizing delay in the completion of the Development Phase and allowing weather service restructuring to proceed. NOAA currently projects a delay of about one year in the Development Phase schedule. As part of the restructuring, NOAA is introducing an early capability prior to the initial AWIPS operations called "Pathfinder," which is scheduled to be placed in selected field offices by May 1995.

The most effective means of schedule control, after a well-defined and managed development process is in place, is to restrict the capabilities that will be included in the initial systems that will be fielded and provide additional capabilities incrementally. In our 1992 inspection report on AWIPS re-baselining, we questioned whether the weather service had, in fact, defined the minimum capabilities needed for initial operations. Although the weather service strongly asserted that it had, it would not cooperate in providing information to support its assertion. We are encouraged, therefore, that the severe problems on AWIPS are causing the weather service to adopt a more reasonable approach to defining what is needed for initial operations.

An overly aggressive schedule has been an important factor contributing to the problems on AWIPS, and we urge NOAA to develop a realistic schedule for the balance of AWIPS. However, we are concerned that the Pathfinder perpetuates NOAA's schedule-driven approach. The Pathfinder will provide only a limited amount of software that is directly transferable to AWIPS, is being developed on a schedule that is likely to compromise the quality of that software, will not incorporate the AWIPS internal software architecture, and will not use the AWIPS user interface. Thus, the Pathfinder will divert essential resources and management attention from the important task of building AWIPS.

B. Inadequate Systems Engineering

We found a lack of technical leadership by PRC and inadequate direction by the program office in the development and documentation of the system design and in the correction of the System

Design Document. Our major concern, as discussed above, is that the structure presented in the document does not show the software design now, nor will it when developed to a more detailed level in subsequent design phases. We find it troubling that PRC's original system design provided neither its technical personnel with a blueprint for developing the software detailed design and code nor its management with a structure for assessing and controlling the work process. The government also has had difficulty in determining and communicating what constitutes an acceptable system design.

Recently there have been improvements in the government/contractor relationship and increased cooperation toward producing a documented system design. PRC had proposed to compensate for the problems of the software structure through the addition of diagrams presenting design information. However, PRC's discussions regarding this approach did not convince us that it is an effective means of describing the design. PRC should structure its design in a more meaningful way, not append explanatory information to correct the shortcomings inherent in its present design. Until recently, PRC appeared to be focused more on preserving the existing software and hardware structure in the System Design Document than on obtaining a useful foundation for further design, development, and management.

Twenty months of Development Phase effort has yielded little technical progress. We believe the inability to develop and document an appropriate system design and to implement a corrective course of action over so long a period of time is attributable, in part, to the need for improved system and software engineering skills at senior management levels both at PRC and in the program office.

Synopsis of NOAA's Comments

NOAA agreed that there has been a lack of technical leadership on AWIPS and a lack of understanding between the government and PRC as to what constitutes an acceptable system design. Consequently, as noted, NOAA has directed PRC to add appropriate technical staff and implement a documented and proven development approach.

OIG Discussion

Since our draft report, PRC has made progress in upgrading its systems engineering staff and is working closely with NOAA to develop the system design. We do not believe, however, that NOAA's approach of designing by committee lends itself to effective systems engineering.

III. The SPO lacks authority to acquire AWIPS

NOAA has undertaken a reorganization in which the SPO's authority and responsibility for acquiring systems, as well as control over its resources, are reduced. The draft Department Organization Order revising NOAA's organization and management sets forth an acquisition

management structure that fails to give either the SPO or the line offices clear responsibility, authority, and accountability for managing major systems acquisitions. It does, however, give the line offices oversight over the SPO in implementing new systems, thereby making the SPO subordinate to them. In practice, the SPO's authority and responsibility for acquiring systems and control over its budget have been returned to the weather service.

With regard to budget, before the reorganization, the program office submitted the AWIPS budget to NOAA and received its funds directly from the NOAA Comptroller's Office. The budget is now submitted through, and funding is received from, the weather service. This arrangement has resulted in decreased funding for the AWIPS acquisition. In this fiscal year, the weather service redirected over $2 million in funds appropriated to the AWIPS acquisition. The weather service has taken an additional $6 million of fiscal year 1994 acquisition funds and placed them in a special account in the Comptroller's Office. The AWIPS Program Manager cannot use these funds without weather service approval.

In the fiscal year 1995 budget process, the weather service redirected about $3.5 million from the AWIPS acquisition to cover activities that were disallowed by the Department and OMB in their passback decisions. After the Department and OMB budget review, NWS took an additional $1 million to cover other weather service requirements. Because cost growth is expected on AWIPS, the program office planned to carry forward excess fiscal year 1994 or 1995 funds, if any, to later years. Under the current budget arrangements, however, the program office cannot rely on receiving funding consistent with Department and OMB decisions or retaining the full amount of funding appropriated to it.

In the acquisition management area, the weather service believes it has the authority to approve all major AWIPS acquisition decisions. Further, weather service officials have attempted to direct the AWIPS Program Manager, and they directly task program office staff members. Weather service officials have briefed congressional staff members on AWIPS acquisition issues and have answered congressional budget questions without a program office representative being present or having input. They have also unilaterally cut the program office's future-year staffing.

Further, AWIPS program office personnel must continually meet and negotiate with the weather service in order to gain its approval before they can carry out their management responsibilities. This gives the weather service undue control over the program office and results in an extra burden on program office personnel at a time when they should be placing maximum effort on solving the problems of the AWIPS acquisition. In addition, the SPO is now required to fill the AWIPS Deputy Program Manager position with a weather service employee. This position is intended to provide feedback to and coordination with the weather service, thereby making many of the additional requirements for coordination and interaction unnecessary. The weather service's representation in the program office has been positive. However, we believe the deputy should be able to extend the authority, influence, and expertise of the program manager. Like the AWIPS Program Manager, the deputy needs to have strong acquisition management and technical skills and experience. Therefore, the program manager needs a deputy who is an experienced

acquisition management professional, with the weather service representative retained in a coordinator position.

The SPO was designed to be independent of NOAA's line offices, report at the Deputy Under Secretary level, and be insulated from operational and budget transfer vulnerabilities. The SPO was set up this way because the weather service lacks the capability to effectively manage major systems acquisitions. With the reorganization, however, the weather service has inserted itself in the decision-making chain between the SPO and the Deputy Under Secretary, thereby undermining the SPO's objectives.

Ambiguous lines of authority and responsibility are intolerable in acquisition management. The AWIPS acquisition is extraordinarily complex, both technically and managerially, requiring sophisticated skills and experience. The weather service lacks the necessary management, contracting, and technical specification skills and experience to acquire AWIPS or any other major system. Moreover, it has an organizational conflict of interest in performing this role since it lacks incentive to challenge unnecessary requirements, restrict changes, and compel trade-offs. It also lacks the qualifications and objectivity to share or direct acquisition management decision-making. For these reasons, it is also inappropriate for the weather service to provide management oversight, as the draft Department Organization Order envisions.
Because the AWIPS Program Office lacks control over its resources and major decisions, it cannot conduct business efficiently and effectively or be held accountable for results. The program office needs to be given full authority, responsibility, and accountability for acquiring the AWIPS system. The weather service should remain intimately involved in establishing requirements for AWIPS and should work closely with the program office and with PRC—under rules established by the program office—to ensure that its operational needs are met. It should also coordinate with the program office to maintain an understanding of the status of the acquisition in relation to the other aspects of the modernization.

We recognize that NOAA's reorganization of major systems acquisition responsibilities was intended to correct the management deficiencies in the SPO and the AWIPS Program Office. However, the new organization has led to a deterioration in the SPO's ability to manage. NOAA needs to improve SPO management and technical capabilities, not abandon the SPO concept. The past failures of the weather service in acquiring complex systems and the current problems on AWIPS are expensive examples of why the SPO must regain the authority and responsibility intended by the Congress and directed by the Department. NOAA and the Department of Commerce cannot afford to return to the failed acquisition management practices of the past.

Synopsis of NOAA's Comments

NOAA disagreed with this finding, commenting that it believes the SPO has the requisite authority to discharge its responsibilities in support of the AWIPS acquisition. NOAA stated that its draft DOO and NAO have clearly delineated the proper roles of the key officials and offices involved in major systems development and acquisition. NOAA pointed out that with regard to

AWIPS, the weather service is responsible for the overall NWS modernization, including the AWIPS system, while the SPO is responsible for acquiring the AWIPS system within the agreed-to program parameters, cost, and schedule. NOAA further pointed out that the draft NAO underscores the importance of each office's bringing to bear its particular expertise to get the job done in the most cost-effective manner. NOAA also said that it plans to improve the SPO's management and technical capabilities and in no way intends to weaken its ability to handle major systems acquisition. NOAA further indicated that the SPO Director would have the authority to select the Deputy Program Manager and that the SPO's funds will be allocated directly to it by the Comptroller's Office.

OIG Discussion

Our review of the DOO and NAO shows that NOAA has not clearly or properly delineated organizational roles and responsibilities as they would apply to AWIPS or any other major system acquisition. Authority, responsibility, and accountability are confused, inconsistent, and ambiguous. As such, it would be impossible for the SPO to determine what management and technical capabilities it needs or how to use them effectively. Our analysis of the draft DOO and NAO is presented in the appendix. Since our draft report, NOAA has chosen to manage and design AWIPS through a hierarchy of committees comprising the weather service, the SPO, and PRC. This approach has introduced further ambiguity about responsibility, authority, and accountability for results.

Although NOAA agreed to have the Comptroller's Office release the SPO's funds directly to it, the draft NOAA Administrative Order on major systems acquisitions, which prescribes the budget formulation and allocation process, still leaves the SPO with insufficient control over its resources. (See the appendix for a discussion of this issue.)

RECOMMENDATIONS

We recommend that the Deputy Under Secretary for Oceans and Atmosphere take the following actions:

Recommendation #1

Return the authority, responsibility, and accountability for AWIPS and NOAA's other major systems acquisitions to the SPO.

Synopsis of NOAA's Response

NOAA disagreed with the premise of this recommendation and asserted that its draft NAO, *Major System Acquisitions*, makes it clear that authority, responsibility, and accountability are not being removed from the SPO.

OIG Discussion

Our analysis of the draft NAO shows a lack of clearly defined and appropriate functions for the SPO and confused, illogical, and ambiguous authority, responsibility, and accountability. Given the current organization, the SPO will remain ineffectual and its ability to recruit, retain, and effectively use capable managers and technical personnel will be severely limited. Returning AWIPS to the SPO will no longer be sufficient. The SPO *must* be permitted to do the job it was established to do and staffed with the capability to do so. Therefore, we reaffirm our recommendation. Our analysis of the NAO is presented in the appendix.

Recommendation #2

Direct the SPO to submit the AWIPS acquisition budget separately from the budget of the National Weather Service.

Synopsis of NOAA's Response

NOAA disagreed with this recommendation, stating that the NWS modernization is a line item/element of the Advance Short-Term Forecasts and Warning Services Subactivity/Initiative. Therefore, it is a component of NOAA Strategic Planning and Reporting System Structure.

OIG Discussion

NOAA has not been responsive to this recommendation. We recommended that the AWIPS acquisition budget be submitted separately because of the weather service's history of redirecting funds in disregard of the Department's and OMB's passback decisions. Therefore, we continue to believe our recommendation is appropriate.

Recommendation #3

Direct the Comptroller's Office to release AWIPS Program Office funds directly to it.

Synopsis of NOAA's Response

NOAA responded that system acquisition funding will be allocated by the Deputy Under Secretary with input from the weather service and the SPO and that the NOAA Comptroller will provide the funds allocated to the weather service and the AWIPS Program Office.

OIG Discussion

It is appropriate for the Comptroller to provide the AWIPS Program Office's funds directly to it, as NOAA has indicated it will do However, we continue to believe that once the SPO's funding level has been established through the budget process, it is inappropriate for the weather service to affect the release of these funds

Recommendation #4

In 60 days, conduct a review of the System Design Document corrective action effort. Assess whether significant progress has been made and determine the prospects for PRC's completing and documenting an acceptable system design. If PRC's ability to do so is in doubt, identify and assess legally-supportable alternative approaches including:

(a) Having the AWIPS Program Office, with assistance from the National Weather Service, develop and document the system design and furnish it to PRC.

(b) Having the AWIPS Program Office, with assistance from the National Weather Service, provide the management direction for the design, development, and implementation of AWIPS, with PRC operating in a support services role.

(c) Terminating the current contract and reprocuring AWIPS.

Synopsis of NOAA's Response

NOAA declined to implement this recommendation, stating that it has chosen to work collaboratively with PRC to develop an AWIPS system design, which will be completed in November 1994. The design will serve as the basis for identifying PRC's and the government's responsibilities for development activities.

OIG Comments

Our recommendation provided four alternative approaches for obtaining the System Design Document. However, NOAA has selected a fifth approach, which it describes as collaborative, but which we view as designing by committee. We do not believe that NOAA's approach is efficient or effective or that NOAA has been responsive to our recommendation. While we believe our recommendation was appropriate, NOAA's actions have rendered it moot.

Recommendation #5

Give the SPO the authority and resources to upgrade the AWIPS Program Office's senior systems and software engineering capabilities through contractor assistance and staffing enhancement, and to reassign staff.

Synopsis of NOAA's Response

NOAA responded that as part of the restructuring of the AWIPS program, it has been reviewing requirements for the program including required systems and software engineering and technical management. NOAA indicated that a new SPO Director and a new AWIPS Acquisition Manager have been selected and that these individuals are in the process of determining needed changes to SPO staffing.

OIG Comments

It is appropriate for the SPO to determine its staffing requirements. However, the SPO's current responsibilities are ill-defined and ambiguous. Thus, we do not believe that it can effectively implement this recommendation at this time.

Recommendation #6

After an acceptable system design is developed and documented, provide the SPO and AWIPS Program Office with the authority and resources to renegotiate the Development Phase contract, including the schedule, cost, statement of work, contract type, deliverables, incentives, and any other areas requiring modification

Synopsis of NOAA's Response

NOAA agreed to implement this recommendation.

Recommendation #7

Reserve the position of deputy to the AWIPS Program Manager for an experienced acquisition management professional.

Synopsis of NOAA's Response

NOAA stated that the SPO is authorized to select a deputy with the skills it deems necessary for the position.

OIG Comments

We made this recommendation because of the previous requirement that the deputy position be filled by a weather service employee. We agree that it is appropriate for the SPO to select its own deputy, and we continue to believe, as we recommended, that the deputy should have extensive major systems acquisition management skills and experience.

APPENDIX

Analysis of Draft Department Organization Order 25-5, *National Oceanic and Atmospheric Administration*, and Draft NOAA Administrative Order, *Major System Acquisitions*[1]

The SPO was created because of NOAA's demonstrated inability to manage the development and acquisition of major systems. This office sought to ensure that the SPO was modelled after organizations that have successfully acquired major systems in the federal government and developed them in the private sector. These organizations have (1) program offices with short, unambiguous lines of authority, (2) managers who are highly skilled and experienced in major systems development and acquisition, (3) funding and requirements that are stable, and (4) sophisticated knowledge of the cost and schedule implications of requirements and the willingness and ability to make trade-offs among them.

The draft DOO and NAO fail to promote any of these features. They describe confused and ambiguous lines of authority, and a management and decision-making approach characterized by a continuous process of complex negotiations and interactions between the line offices and the SPO. They establish an extremely inefficient and ineffective process requiring that key managers and staff spend extraordinary amounts of time in meetings and negotiations, and make excessive efforts to reach agreement and consensus. The inefficiency and difficulty of doing business this way will be exacerbated because these directives provide for the SPO to (1) obtain concurrence from the line offices on decisions about which these offices lack expertise, and (2) participate in areas about which it is not knowledgeable.

Most importantly, the proposed DOO and NAO inappropriately give the line offices oversight over the SPO. This makes the SPO subordinate to them and compromises the independent reporting chain to the Deputy Under Secretary that the SPO was intended to have. This arrangement also obscures accountability. The SPO's subordinate status is further reinforced by giving the weather service "overall program management" responsibility. In the case of AWIPS, this responsibility, according to NOAA's response to our draft report, includes responsibility for the AWIPS system. Essentially, the SPO has been relegated to a support organization on AWIPS operating under the direction and oversight of the National Weather Service.

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[1]The DOO reviewed here is the version submitted to the Assistant Secretary for Administration for clearance (no date). The NAO reviewed here is dated July 21, 1994 and was approved by the Under Secretary for Oceans and Atmosphere on August 12. It is referred to as a draft because it has not yet been officially published and may receive minor editing and formatting changes. This version supersedes the July 11 draft, which was transmitted with NOAA's response to our draft inspection report.

This organization is inappropriate because the weather service and other line offices lack the necessary management, contracting, and technical skills to effectively perform a major systems oversight function or manage a major systems acquisition. In its response, NOAA asserts that the SPO is responsible for acquiring the AWIPS system within the agreed-to program parameters, cost, and schedule and the DOO charges the SPO with conducting systems acquisitions "to ensure that major systems requirements of NOAA are met in the most effective, efficient manner." However, the SPO has so little control or influence over the systems design, management, and schedule that it would be impossible to hold it accountable for efficiency, effectiveness, or results.

In some cases, the DOO and NAO give the SPO what appears to be appropriate authority or responsibility, such as to develop a cost, schedule, and technical performance baseline or to manage a system acquisition. However, these directives fail to give the SPO control over the work, decisions, and resources that are essential to carrying out such responsibilities. Lacking definite responsibility for such tasks as systems engineering, trade-off analysis, configuration management, and milestone determination, the SPO cannot be expected to develop a baseline or manage an acquisition. Without control over the resources on which it must depend to carry out its objectives, the SPO cannot be held accountable for results.

In fact, almost every responsibility granted the SPO is subject to "collaboration," "close collaboration," "concurrence," "participation," "approval," or "oversight" by the line offices. Not only is it unclear what these terms mean in the context of the DOO and NAO and what the intended distinctions among them might be, but given the SPO's virtual complete lack of autonomy and the dispersion of responsibilities, it would be impossible to hold either the SPO or the line offices accountable for results. Indeed, it is not apparent from these directives even the results for which the SPO or the line offices would be accountable. For example, the NAO would have the SPO execute "delivery of systems," while having the line offices execute "delivery of end user products" Since the systems delivered by the SPO presumably are intended to perform end user functions, there is no discernable distinction between these two responsibilities.

These directives, in effect, permit the line offices to manage and control major systems acquisitions, but these offices lack the skills and experience to do so. Moreover, given the SPO's ambiguous and restricted role, its ability to attract, retain, and effectively use highly skilled and experienced major systems acquisition managers is severely limited.

The NAO has taken a step toward improving budget stability for major systems acquisition by prescribing that the SPO's funding be allocated directly to it by the Deputy Under Secretary. However, problems that undermine stability remain. Specifically, rather than establishing a funding baseline subject to modification only under exceptional circumstances, the NAO institutionalizes renegotiation of that funding between the line offices and the SPO each year. Further, once funding is established, the organization accountable for managing the "acquisition cost baseline" is ambiguous: One part of the NAO tasks the SPO with controlling system

acquisition funds within the approved funding profiles, while another part splits accountability for managing the acquisition cost baseline between the SPO and the line offices.

The NAO also does not support requirements stability since it makes no single organization responsible for controlling requirements. Rather, program requirements are to be managed and controlled jointly by the line offices and SPO through a "structured change management process." It is not even clear what program requirements are and what their relationship may be to the systems that are being acquired. The NAO uses the terms mission requirements and program requirements, but the DOO uses an entirely different set of terms, which include overall systems requirements, major systems requirements, operational requirements, and user requirements. None of these terms are defined or explained, and it is impossible to determine what they mean or what the distinctions among them are. (We found that unclear terminology pervades both directives, thereby increasing the difficulty of determining what NOAA considers to be major systems acquisition functions and what each organization's responsibilities are intended to be.)

Similarly, configuration management is a key element for controlling system changes and thus attaining stability. Responsibilities in this regard should be spelled out with particular care in a directive on major systems acquisition. However, the NAO is vague as to what organization, if any, is in charge of configuration management. The NAO would have the SPO "establish systems and processes for . . . configuration management," and states that approvals of systems changes after contract award "will involve the Deputy Under Secretary, mission and program mangers, and the SAO, prior to budget submission." Although it is not clear precisely what being "involved" in approval means, performing configuration management at the Deputy Under Secretary level is extremely inefficient and unusual.

Because of its omissions and ambiguities, the NAO also fails to promote the ability to make cost, schedule, and technical performance trade-offs. Fundamental to such trade-offs are system design studies and systems engineering analyses. The NAO states that the line offices' responsibilities include "Participating in the development of system concept designs (sic)" and that the SPO's responsibilities include "Supporting" the line offices "in . . . the concept studies exploration of alternative system design concepts . . ." Thus, the line offices are to "participate" and the SPO is to "support," but no one is in charge or accountable. With regard to systems engineering, the SPO "will provide the . . . systems engineering . . . functions and processes that will guide the acquisition from inception through delivery." The NAO also directs the SPO to " lead an interactive systems engineering process to develop contract specifications for the acquisition process . . . in close collaboration with the line offices." However, for each program, the NAO also would have the Deputy Under Secretary prescribe system engineering responsibilities, suggesting that notwithstanding the SPO's assignment to provided systems engineering functions, processes, and leadership, it will not necessarily be responsible for systems engineering on a particular program. The intent is unclear.

The DOO provides no clarification on this point. Rather, it adds to the confusion by stating that the SPO will "support the agency and its organizations by participating in the development of

systems analyses, trade-off studies, and operational requirements." But another section of the DOO states that the SPO "performs system design studies . . . that *are the basis for* system alternatives, trade-offs, and development [emphasis added]." But "participating in" and "performing" are two different things. Also, according to the DOO, the line offices will "work with" the SPO in developing system analyses and system engineering trade-off studies. As a result of this language, no organization has clear given authority and responsibility for carrying out this work. Furthermore, no organization is responsible for determining system alternatives or making trade-offs. Thus, no organization is responsible for or has control of the work that is fundamental to making trade-offs and developing systems designs. Finally, it is inappropriate for the SPO to participate in the development of operational requirements since it lacks expertise in the line offices' operations.

Because of the high degree of managerial and technical complexity and the large quantity and rapid rate of resource expenditure on AWIPS and other major systems acquisitions, clear delineation of authority, responsibility, and accountability are particularly important. Although this analysis of the DOO and NAO is not exhaustive, it demonstrates that NOAA has failed to establish an organizational foundation for efficiently or effectively conducting major systems acquisitions.

ATTACHMENT

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Washington, D.C. 20230

OFFICE OF THE COMPTROLLER

AUG 16 1994

MEMORANDUM FOR: Frank DeGeorge
Inspector General

FROM: Andrew Moxam

SUBJECT: Draft OIG Inspection Report: Management and Engineering Problems Halt AWIPS Progress (SED-6623-4-0001)

We appreciate the Inspector General's review of our June 28, 1994 response to the AWIPS inspection report. Having reviewed the original response, I agree with your comments to the Deputy Under Secretary on its lack of specificity. The attached revision more specifically addresses each significant report finding, conclusion, and recommendation.

Attachment

NOAA RESPONSE
to
OIG Draft Inspection Report

MANAGEMENT AND ENGINEERING PROBLEMS HALT AWIPS PROGRESS
(SED-6623-4-0001)

GENERAL COMMENTS:

NOAA agrees that management and engineering problems in fact halted AWIPS's progress as asserted by the Office of the Inspector General (OIG), both in this and previous reports. We have committed ourselves to addressing each management and engineering problem, and to solving them.

NOAA disagrees that it has returned control of the AWIPS acquisition to the National Weather Service (NWS). We strongly endorse the continued importance of the SPO (called Systems Acquisition Office (SAO) in this response). NOAA continues to provide it the full range of authority needed to carry out this major systems acquisition responsibilities.

We have used the draft Departmental Organizational Order (DOO) and the draft NOAA Administrative Order (NAO), currently in final clearance, to delineate respective functions and further define roles and responsibilities. Copies are attached for your information.

In addition, we agree that a system design and a revised development approach is needed to direct the development work and to estimate revised costs and schedules. The lack of an acceptable design would, as the IG report suggests, raise serious questions about the agency's ability successfully to field an AWIPS system. We also agree that the AWIPS contract may need substantive revision after an acceptable System Design Document is produced. However, we also believe that NOAA and the PRC can successfully develop and deploy AWIPS if necessary restructuring actions are taken quickly.

NOAA is taking seriously the expressed desire of Deputy Secretary Barram for a strategy which will accelerate the development and deployment of AWIPS.

Detailed Comments:

Executive Summary:

The Report

Background

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We do not agree that the Development Phase solicitation was incomplete, disorganized, and ambiguous.

Based on recommendations made in a 2/18/92 draft inspection report from the OIG[1], changes were made to the Development Phase solicitation.[2] Also, in early 1992, and prior to entering negotiations, Mr. Raymond Kammer, then Deputy Under Secretary for Oceans and Atmosphere, had a review of the AWIPS procurement conducted by Dr. Joseph F. Shea, Adjunct Professor with Massachusetts Institute of Technology. Mr. Shea reviewed program plans, the solicitation, and the then draft of the IG report. His recommendation was that we "Finish editing the RFP as recommended [by the draft IG report], but do not alter the technical content which seems to be logical"[3]. As mentioned above, this work was concluded before entering negotiations. In Dr. Shea's concluding statements he stated, "In summary, the AWIPS procurement, as presently structured, is well planned, and rigorously specified."

Observations and Conclusions:

I. **AWIPS lacks a reliable technical foundation for system development.**

NOAA agrees that the current system design document does not provide a reliable technical foundation for the reasons cited by the OIG. NOAA has taken the following steps to

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[1]AWIPS Re-baselining and Associated Issues, U.S. Department of Commerce, Office of Inspector General, Systems Evaluation Division, SED 4585-2-0001, May, 1992

[2]See Memorandum from Ray Kammer to Frank DeGeorge dated 3/19/92, subject: Draft Inspection Report on AWIPS Rebaselining and associated issues (Report No. SED-4585-2-0001)

[3]Letter from Joseph F. Shea, Massachusetts Institute of Technology to Mr. Raymond Kammer, dated March 30, 1992.

ensure that we have a complete and reliable design. 1) Directed the Planning Research Corporation (PRC) to add appropriate technical staff. PRC has added key technical people including a System Engineer, and is in the process of adding other people. 2) Directed PRC to adopt a documented, proven development approach for Advanced Weather Interactive Processing System (AWIPS). PRC presented a development approach tailored to the AWIPS system in late May. A Life Cycle System Engineering Team has been set up with PRC and government participation to refine PRC's proposed approach. 3) Implemented a series of steps to lead to an acceptable system design. These steps which begin with a functional decomposition of AWIPS requirements and culminate with a system design are being accomplished with strong government participation.

II. **An unrealistic schedule and inadequate systems engineering have halted AWIPS progress.**

NOAA agrees that the $7.5M schedule incentive has adversely impacted PRC's overall performance of the contract. NOAA is currently evaluating the total development effort, including schedules and incentive structure.

We also agree that there has been a lack of technical leadership in the AWIPS development effort. In addition, there has been a lack of understanding between the government and PRC as to what constitutes an acceptable system design.

To correct this situation, NOAA has undertaken the actions mentioned under Observation I, above and Recommendation 5, below.

III. **The SPO lacks authority to acquire AWIPS.**

NOAA disagrees with this conclusion. We believe that the Systems Acquisition Office (SAO) has the requisite authority to discharge its responsibilities in support of the AWIPS acquisition. The draft Departmental Administrative Order (DAO) and NOAA Administrative Order (NAO), currently in final clearance, clearly delineate the roles and responsibilities of the key officials and offices involved in major systems development and acquisition. The NAO envisions a collaborative management structure with specific clearly defined roles for the Mission Manager, Program Manager, SAO Director, and the Systems Acquisition Manager. It is incumbent upon each of the parties to this process to ensure that there has been full and complete coordination with the others at each and every stage of the process.

The AWIPS acquisition, not unlike other major system acquisition, cannot be developed in a vacuum. It must ultimately serve the needs and meet the requirements of the mission agency, the National Weather Service. It is the Mission Manager who is responsible for the overall level of service provided to the American public and for ensuring that the service is maintained and kept current with evolving technology. In that regard, the National Weather Service is and will continue to be responsible for the overall NWS modernization program, including the AWIPS system. The Program Manager, in this case also the National Weather Service, is responsible for total program execution from defining the program requirements through development of the overall program, implementation, and delivery of user products. The SAO is responsible for acquiring the AWIPS system within the agreed-to program parameters, cost, and schedule. The draft NAO underscores the importance of each office in bringing to bear their particular expertise to get the job done in the most cost-effective manner. The SAO role and responsibility in this regard is critical and is being given full support by NOAA management. NOAA has every intention of improving SAO management and technical capabilities and in no way intends to weaken SAO's ability to handle major systems acquisitions.

Regarding the budget process, the draft NAO provides for a process that will engage the Mission Manager, Program Manager, and Systems Acquisition Manager in a process that will arrive at an agreed-to program budget and plan for the current year subject to available resources. All issues will be resolved by the Deputy Under Secretary and funds will be allocated by the Comptroller's Office directly to the respective offices, i.e. the Weather Service, SAO, etc. as provided for in the plan.

RECOMMENDATIONS:

1. Return the authority, responsibility, and accountability for AWIPS and NOAA's other major systems acquisition to the SPO.

   NOAA Response:

   NOAA does not agree with the premise of this recommendation. NOAA makes it clear in the draft NAO that authority, responsibility, and accountability are not being removed from the SAO. We include a copy of the draft document as an attachment.

2. Direct the SPO to submit the AWIPS acquisition budget separately from the budget of the National Weather Service.

NOAA Response:

We disagree with this recommendation. As described above in our response to Observations and Conclusions III, the Director, SAO will approve system acquisition budgets in collaboration with the mission and program managers. The system acquisition budget will be incorporated into the program budget submission to NOAA. NOAA's program budget flows from and is linked to the agency's Strategic plan. There is no separate budget for NOAA Line or staff entities, nor for specific NOAA projects or programs. The NWS Modernization is a Line item/element of the Advance Short-Term Forecasts and Warning Services Subactivity/Initiative. As such it is a component of NOAA Strategic Planning and Reporting System Structure.

3. Direct the Comptroller's Office to release AWIPS Program Office funds directly to it.

NOAA Response:

As indicated above, the draft NAO provides that the system acquisition funding will be allocated by the Deputy Under Secretary (DUS) of NOAA with input from the Mission Manager and the SAO, and that the NOAA Comptroller will provide the funds allocated to the Program Manager and the System Acquisition Manager.

4. In 60 days, conduct a review of the System Design Document corrective action effort. Assess whether significant progress has been made and determine the prospect's for PRC's completing and documenting an acceptable system design. If PRC's ability to do so is in doubt, identify and assess alternative approaches including:

   (a) Having the AWIPS Program Office, with the assistance from the National Weather Service, develop and document the system design and furnish it to PRC.

   (b) Having the AWIPS Program Office, with assistance from the NWS, provide the management direction for the design, development, and implementation of AWIPS, with PRC operating in a support services role.

   c) Terminating the current contract and reprocuring AWIPS.

NOAA Response:

- NOAA considered this recommendation along with those from other sources in developing its plan for restructuring the AWIPS program. Our selected approach, which has been briefed to the Department, is to work collaboratively with PRC to develop an AWIPS system design. These activities are identified in the AWIPS Restructure Implementation Plan (7/8/94, draft) and are currently underway. Our schedule shows the completion of an AWIPS System Design in November, 1994. This design will serve as the basis for identifying responsibilities between PRC and the government for development activities. NOAA is reviewing progress monthly and the Department is being briefed bi-monthly.

5. Give the SPO authority and resources to upgrade the AWIPS Program Office's senior systems and software engineering capabilities through contractor assistance and staffing enhancement, and to reassign staff.

NOAA Response:

As part of the Restructuring of the AWIPS Program, NOAA has been reviewing the requirements for the program including required systems and software engineering and technical management. Recently, a new Director of the SAO has been selected, as well as a new AWIPS Acquisition Manager. These individuals are in the process of determining needed changes to the staffing complement of the SAO.

6. After an acceptable system design is developed and documented, provide the SPO and AWIPS Program Office with the authority and resources to renegotiate the Development Phase contract, including the schedule, cost statement of work, contract type, deliverables, incentives, and other areas requiring modification.

NOAA Response:

Once an acceptable system design is developed and documented, it will be the basis for identifying government and PRC responsibilities for the remainder of the development phase. The Program Manager and the System Acquisition Manager will obtain the concurrence of the Director, SAO, and the Mission Manager(s) with the revised approaches prior to obtaining the DUS and DOC approvals to proceed. At that time, the appropriate authority and resources will be provided to the SAO to renegotiate the Development Phase contract.

Reserve the position of deputy to the AWIPS Program Manager for an experienced acquisition management professional.

NOAA Response:

As noted in the response to Recommendation 5, NOAA is currently reviewing technical and management requirements of the program. While not explicitly stated in the NAO, the AWIPS System Acquisition Manager and the Director, SAO are authorized to select a deputy System Acquisition Manager with the skills they deem necessary in that position.

FINAL INSPECTION REPORT

AWIPS RE-BASELINING AND ASSOCIATED ISSUES
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

REPORT NO. SED-4585-2-0001

MAY 1992

U.S. DEPARTMENT OF COMMERCE
OFFICE OF INSPECTOR GENERAL
SYSTEMS EVALUATION DIVISION

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EXECUTIVE SUMMARY

At the time of our inspection, the National Oceanic and Atmospheric Administration was revising the schedule and technical requirements for AWIPS, the Advanced Weather Interactive Processing System. Three NOAA organizations are involved in AWIPS. As the weather system's user, the National Weather Service is responsible for identifying requirements. The Systems Program Office is responsible for managing the AWIPS program, including the AWIPS development contract. The Forecast Systems Laboratory is responsible for developing a prototype of the AWIPS workstation environment. AWIPS is a necessary and important part of the NWS modernization program. However, during our review of the status of this $500 million project we identified significant risks associated with the acquisition strategy.

In our draft report of February 18, 1992, we were particularly concerned that the planned strategy of furnishing the AWIPS development contractor with large amounts of government-developed software posed excessive risk. This strategy would obscure the contractor's responsibility for developing and maintaining the system and place NOAA's Systems Program Office in the untenable position of having to manage government software development organizations over which it lacks authority. We were also concerned that the request for proposal for the AWIPS development contract was improperly prepared and did not form the basis for an effective contract.

The major conclusions of our draft report were as follows:

- **The NWS had not adequately justified its minimum requirements for the new system and had not prioritized the system's additional functions.** More complete information must be developed and presented in nontechnical language so that upper-level managers and oversight organizations can have confidence in the validity of the results. The cost and complexity of this project, the difficulties and delays experienced so far, the importance of the program to the weather service's modernization efforts—all of these factors make it essential that NWS adequately document and justify its decisions on system requirements. (See page 2.)

- **Mandating the use of government-developed software is extremely undesirable.** NOAA plans to require the contractor to use software that was developed primarily by federal meteorologists and hydrologists, not by professional software engineers. Since rigorous software development practices are not typically used by NOAA, the

reliability, maintainability, and expandability of the software are in doubt. At the time of our draft report, NOAA planned to restrict the contractor from modifying parts of the software, and this created serious risks. In particular, the contractor was expected to achieve system requirements, while being denied full latitude in system implementation. If the contractor failed to meet requirements or experienced cost overruns, it would be unclear whether the government or the contractor was at fault. This arrangement placed the government at risk for enormous cost growth, for unpredictable claims by the contractor, or for entering into a contract that the contractor could not fulfill. (See page 4.)

- **NOAA's strategy to achieve its revised schedule increases risk.** As part of replanning, NOAA intends to increase the amount of government-developed software. This strategy would further obscure the contractor's responsibility and increase the amount of software developed by personnel who lack sufficient training in—and appreciation for—software engineering. Instead of developing software for the new system, NWS specialists should apply their expertise to writing the specifications for software that will be developed by the contractor. Equitable and efficient means of resolving disputes over government developed software cannot be readily formulated or effectively implemented. (See page 6.)

- **The Systems Program Office lacks authority over NOAA's software development organizations, but will be responsible for their results.** The Systems Program Office is responsible for overseeing the development and deployment of the new weather system, but lacks authority over the NOAA organizations that develop software to be furnished to the contractor. In addition, the Systems Program Office is already understaffed for its current responsibilities. Consequently, an already overcommitted Systems Program Office will be faced with the responsibility of managing a critical major system acquisition contract, while simultaneously ensuring—without adequate authority—that the NWS software development efforts yield production-quality software. (See page 9.)

- **NOAA's request for proposal, which forms the basis for the future contract, is poorly organized, contains redundant information, and presents ambiguous requirements.** These problems create a serious risk of a contract that will be difficult to administer and to disputes that will be difficult, if not impossible, to resolve. We recommended that the request for proposal be revised before contract award. We noted that such revisions should not negatively affect the offeror's proposals since only repetitions, ambiguities, contradictions, and omissions would be corrected; the intent of the contract would not change. The new weather system's contract is too large, complex, and critical to depend on the good faith of the parties to compensate for the risks inherent in a poorly-drafted contract. (See page 11.)

We presented alternative recommendations concerning use of government-developed software. We strongly recommended that the contractor *not* be required to use government-developed software. However, if the use of government-developed software continued to be required, we recommended that NOAA assume responsibility for maintaining the new weather system.

Our detailed recommendations begin on page 14. We present each recommendation, a synopsis of NOAA's response, and our comments on NOAA's response. A copy of NOAA's response is attached.

NOAA has not yet adequately justified its requirements in response to our draft report. In particular, NOAA still needs to identify the specific applications that will permit release of the current weather information system (AFOS), provide the schedule for implementation of these applications, and present the rationale for that schedule.

With respect to software, NOAA responded that it does not intend to require the use of government-developed software and changed this requirement in the technical specifications. The change allows the contractor to modify government-furnished software with government approval. NOAA also inserted a contract clause giving total system responsibility to the contractor. Although these changes are improvements, they still fall short of our recommendation of giving full latitude to the contractor in implementing AWIPS software.

NOAA further responded that it does not wish to maintain the new weather system, and said that the Systems Program Office and NWS will develop standards to guide in-house software development and to establish the content of materials to be furnished to the AWIPS contractor. We agree that standards are needed, but note that the software and documentation being furnished to the contractor initially have been developed without these standards. Moreover, we see no provisions being made for enforcing standards for government software development and for educating software development personnel in their use.

Finally, NOAA said that it agrees with our recommendation to revise the solicitation and convened a team to do this. The steps taken to revise the solicitation have yielded some improvement, but in our view it still has substantial problems. We believe that the Systems Program Office is taking an unnecessary risk in issuing a poorly-constructed contract. Since NOAA does not plan to award the AWIPS contract until late 1992, we believe there is still time to make the modifications necessary to obtain a clear and enforceable contract.

INTRODUCTION

At the time of our inspection, the National Oceanic and Atmospheric Administration was revising the schedule and technical requirements for AWIPS, the Advanced Weather Interactive Processing System. Three NOAA organizations are involved in AWIPS. As the weather system's user, the National Weather Service is responsible for identifying requirements. The Systems Program Office is responsible for managing the AWIPS program, including the AWIPS development contract. The Forecast Systems Laboratory in the Office of Oceanic and Atmospheric Research is responsible for developing a prototype of the AWIPS workstation environment. AWIPS is a necessary and important part of the NWS modernization program. However, during our review of the status of this $500 million project we identified significant risks associated with the acquisition strategy.

Two contractors are competing to establish the system design for AWIPS and have submitted proposals for the single contract that will be awarded to implement the design. This contract will include an option for deploying and maintaining the system.

In October 1991, the Systems Program Office concluded that its plans for technical requirements and schedule could not be achieved. Because of this, the Systems Program Office initiated an effort to re-baseline the program—that is, to adjust these plans. The guidance for re-baselining is presented in a memorandum from Robert M. Valone, Director, Systems Program Office to Elbert W. Friday, Associate Administrator, National Weather Service.[1]

As indicated in the memorandum, the schedule could not be met primarily because of the immaturity of the contractors' system designs and the large amount of software to be developed. As a result, the Systems Program Office decided that the technical requirements for initial AWIPS installations should be reduced and the schedule for implementation should be revised. The Systems Program Office also decided that the re-baselined requirements should be reflected in a modified request for proposal so that revised proposals could be obtained from both contractors. The Systems Program Office requested NWS to determine its minimum requirements and prioritize additional functions. An amended request for proposal was issued on May 8, 1992.

[1]Memorandum from Robert M. Valone, Director, Systems Program Office to Elbert W. Friday, Associate Administrator, National Weather Service, entitled "Re-baselining the AWIPS Development and Deployment Phase Schedules," October 10, 1991.

PURPOSE AND SCOPE

The purpose of our inspection was to determine (1) whether the revisions to the AWIPS requirements and schedule were appropriate and (2) whether technical, contractual, and schedule risks exist in the AWIPS program. Our report incorporates information obtained from key officials in the National Weather Service and the Systems Program Office. We also reviewed the weather service's January 1992 memorandum[2] concerning the adjustment of requirements and schedule for the project and the October 1990 AWIPS/NOAAPORT request for proposal through Amendment 6. Since the release of our draft report, we visited NOAA's Forecast Systems Laboratory.

Since inspections are designed for quick corrective action by agency managers, they generally do not include the detailed analysis normally associated with management audits. Our work was conducted in accordance with the *Interim Standards for Inspections* issued by the President's Council on Integrity and Efficiency.

CONCLUSIONS

I. The NWS has not adequately justified its minimum requirements for the new system.

A key part of re-baselining is to define the minimum requirements needed for initial installations and prioritize the additional functions. The Systems Program Office requested NWS to perform this task. The NWS concluded that all of the functional capabilities that were previously planned are still needed. Therefore, NWS focused on how development of the software to satisfy all planned functionality will be rescheduled. The NWS Associate Administrator's memorandum identified three newly defined milestones—First Article, First Pre-planned Product Improvement, and Second Pre-planned Product Improvement—and provided a preliminary list of applications needed at the first two. The NWS memorandum also identified the criteria used to guide the re-baselining: (1) obtain those capabilities needed to release AFOS units, and (2) capitalize on the new, high resolution data sources in support of the warning and short-range forecasting mission.[3] These criteria were used in

[2] Memorandum from Elbert W. Friday Jr. to Robert M. Valone, entitled "AWIPS Re-baselining," January 10, 1992.

[3] Memorandum from Friday to Valone, p. 2.

1989 to define the functionality for initial installations.[4] A third criterion used previously, achieving staff savings, was only minimally used in the re-baselining.[5]

The First Article, which at the time of our inspection was supposed to incorporate the minimum functionality needed, was formulated according to these criteria and the following guidelines:[6]

- Applications supporting advisory, watch, and warning functions should be included since these are the highest priorities of the NWS.

- Applications supporting the integration of new observational data sets (i.e., data from NEXRAD, ASOS, GOES-I, and the Profilers) should be included since "...It has been shown that the integration of observational data sets provides valuable information to support the warning program."

- The AFOS equivalent of the verification and monitoring capabilities should be included to move toward performing all Weather Forecast Office functions on the AWIPS workstations.

- Weather Forecast Office hydrological techniques (which support issuance of flash flood watch and warnings) should be included since "...Integration of the hydrological program has been one of the goals of the MAR [Modernization and Associated Restructuring] and has been the subject of considerable development work by OH [Office of Hydrology] and FSL [Forecast Systems Laboratory]."

- Applications that streamline the Weather Forecast Office work effort and also support either watch/warning services or are driven by the new observational data sets should be included since Weather Forecast Office staffing is an important issue.

- Some marine and Console Replacement System applications should be included since the First Article will be the initial capability at many sites.

Notwithstanding the criteria and guidelines, it is not apparent why the applications selected for the First Article represent the minimum functionality needed, and the NWS did not prioritize subsequent applications, as requested by the Systems Program Office. To permit a better understanding of the capabilities that the various applications provide and the tradeoffs

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[4]Memorandum from Ronald L. Lavoie to Directors, All NWS Regions, entitled "AWIPS Rebaselining Activities," December 9, 1991, p. 2.

[5]Memorandum from Lavoie to Directors, All NWS Regions, p. 2.

[6]Memorandum from Lavoie to Directors, All NWS Regions, Attachment 2.

that were made, the NWS should identify those applications that (1) allow release of AFOS units, (2) permit enhanced service, and (3) reduce staff effort or staffing levels.

The NWS personnel involved in re-baselining are experts in meteorology and associated fields, have worked together for many years, and share a similar knowledge base and understanding of NWS operations and what AWIPS and the NWS modernization effort are supposed to achieve. This familiarity may seem to obviate the need for presenting more complete information to justify the selected applications. However, such information must be developed and put in nontechnical language so that upper-level managers and oversight organizations can have confidence in the validity of the results. The cost and complexity of AWIPS, the difficulties experienced in the program so far, and its vital importance to NWS modernization make it essential that all relevant parties understand and have confidence in the rebaselining decisions.

II. Government software development increases technical, contractual, and schedule risk.

Technique Specification Packages define the requirements for the hydrometeorological applications software or techniques. Technique Specification Packages are divided into three categories. Our concern is with Category I, which contains plain language specifications accompanied by working code that is said to meet the stated technique requirements. The contractor is required to integrate this software into AWIPS.[7]

At the time of our draft report, the AWIPS *System Requirements Specification* required that Category I software be integrated into AWIPS by adapting it to the language, hardware, operating system, data management system, display interfaces, and software architecture used to implement AWIPS.[8] Category I software is being developed primarily by government personnel, generally by meteorologists and hydrologists, not by professional software engineers and computer scientists. Our discussions with scientists developing the software and their managers indicated that rigorous software engineering practices typically are not used; therefore, it is not known whether the software is reliable, maintainable, and expandable.

The *System Requirements Specification* stated, "The government recognizes that the Category I working code it provides might require the contractor to perform some system-dependent

[7]AWIPS/NOAAPORT Request for Proposal, October 22, 1990, *System Requirements Specification*, Volume I, p. SRSI-8-2.

[8]AWIPS/NOAAPORT Request for Proposal, October 22, 1990, *System Requirements Specification*, Volume I, p. SRSI-8-2.

modification to integrate the code into AWIPS."[9] The request for proposal was silent as to whether the contractor could make changes other than to system-dependent portions of the software.[10] Discussions with Systems Program Office, NWS, and contracts personnel revealed differences of opinion regarding the extent to which the contractor would be permitted to make changes to Category I software other than modifications needed for integration. Opinions ranged from strongly discouraging the contractor from making any modifications at all, outside those needed for integration, to allowing some additional changes to be made, although the extent of allowable changes and how they would be controlled were unclear.

The government plans to furnish for integration into AWIPS a large software model (approximately 270,000 lines of code) for the River Forecast Centers and to furnish additional hydrological software for the Weather Forecast Offices. Prototype software for the River Forecast Center model has been under development by the Office of Hydrology for over ten years. Portions of this model, as well as portions of the Weather Forecast Office hydrological applications will also run in non-AWIPS government environments, and therefore must be kept uniform. The Office of Hydrology intends to retain responsibility for the correctness and performance of the scientific and associated processing and analysis software. That is, the contractor will be prohibited from changing this software during development and will not maintain it. According to the Office of Hydrology, the contractor will be responsible only for the systems software.[11] As with all Category I software, the request for proposal was ambiguous about the extent to which the contractor may make software changes.

In our draft inspection report we pointed out that these ambiguities should be resolved before contract award to reduce risk to the government. We recommended that the contractor be given latitude to change software as needed to satisfy functional, performance, and quality requirements. It should be noted that the AWIPS contract will require the contractor to perform maintenance of the AWIPS software at a fixed price. The winning contractor will need to meet all performance requirements and to satisfy stringent system availability requirements. Restricting the contractor from modifying the software is extremely undesirable under this contract structure since the contractor would be expected to achieve system requirements while being denied full latitude in system implementation. In the event of failure to meet operational requirements or cost overruns during operations and

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[9]AWIPS/NOAAPORT Request for Proposal, October 22, 1990, *System Requirements Specification*, Volume I, p. SRSI-8-2.

[10]AWIPS/NOAAPORT Request for Proposal, October 22, 1990, *System Requirements Specification*, Volume I, pp. SRSI-8-2—SRSI-8-3.

[11]AWIPS defines systems software as communications, data management, display interface, and other non-hydrometeorological software.

maintenance, it would be unclear as to whether the contractor or the government is at fault. Similarly, it would be difficult to fix responsibility for problems during development and deployment. This arrangement placed the government at risk of enormous cost growth, of unpredictable claims, or of entering into a contract that the contractor simply cannot fulfill.

In response to our draft inspection report, the Systems Program Office changed the *System Requirements Specification* to allow the contractor to modify Category I software with government approval. It also added a contract clause giving total system responsibility to the contractor. These changes offer some improvement, although they fall short of our recommendation of giving full latitude to the contractor in implementing AWIPS software. Moreover, the effectiveness of the total system responsibility clause is problematic if the government disapproves of contractor-requested changes.

With regard to the River Forecast Model discussed above, the Office of Hydrology has already identified in a Technique Specification Package the software procedures and functions that may be altered by the contractor without additional government approval. According to the Technique Specification Package, however, there are parts of the software that the contractor may not change. We concluded from our discussions with Office of Hydrology management that no policy has yet been established for how changes to this software would be handled if the contractor were to propose an alternate implementation.

III. Additional government software development to achieve the re-baselined schedule further increases risk.

A major part of the strategy planned for achieving the re-baselined schedule is for NWS to increase the amount of applications software that it will develop and to develop this software to a more advanced stage than previously planned. Under re-baselining, the government will develop and integrate into AWIPS approximately 71,500 lines of code for the first Pre-planned Product Improvement, and will do the same for an unspecified quantity of software for the second Pre-planned Product Improvement.

Whereas Category I software is provided to the contractor for integration, the software discussed here is to be developed and integrated into AWIPS by the government, with the intention of the contractor's undertaking the most minimal efforts possible to make this software work with the rest of AWIPS. The NWS asserts that the planned increase in government software development is justified by the necessity of the developers to have "a deep understanding of NWS operations and services," and states that the government will develop as much software as is cost-effective within staffing and development facilities

limitations.[12] The NWS also points out that a significant amount of this software is already in an advanced stage of development.[13]

At the time of our inspection, we believed this strategy had not been sufficiently justified and was extremely undesirable. In particular, it would obscure the contractor's responsibility for the successful development and operation of AWIPS, place development responsibility in the hands of organizations whose personnel lack training in and appreciation for software engineering, and require the Systems Program Office to manage not only a large and complex major system acquisition contract, but also to manage several different government software development organizations. The potential problems in delivery and maintenance of government-developed software could easily offset any schedule or technical advantage the government receives from developing software in-house.

A. Contractor's responsibility for delivering, operating, and maintaining AWIPS is obscured.

The government's developing and integrating software into AWIPS increases risk by making responsibility for performance of the software unclear. According to the Systems Program Office and NWS, the contractor will develop and follow an acceptance procedure whereby through testing and perhaps other methods the government-developed software will be determined to satisfy its specified functions, without degrading system performance. This procedure, as-yet undefined, is intended to allow unambiguous transfer of responsibility for the software from the government to the contractor. Since software of the size and complexity of that needed for AWIPS will have latent errors, problems can arise at any time, even after the contractor's acceptance of the software. Such problems can compromise the contractor's responsibility for delivery and performance of AWIPS during development and deployment, as well as for performance during operations and maintenance.

If problems arise in the government-developed software that jeopardize the ability of the contractor to deliver the system on time or to operate the system according to its specifications and at the fixed price, the contractor's only reasonable alternatives are: (1) to place responsibility on the government as the builder of the software, (2) to incur cost growth in the cost plus software development part of the contract, and (3) to submit claims for fixed-price overruns. The contractor may also submit claims if the source of the problem is ambiguous. Since ambiguities are commonly resolved in favor of the contractor, we could expect this outcome on the AWIPS contract. We do not believe that equitable and efficient means of resolving disputes and ambiguities

[12]Memorandum from Friday to Valone, p. 2.

[13]Memorandum from Friday to Valone, p. 3.

over government-developed software can be readily formulated and effectively implemented. Such disputes and ambiguities will cause work to be stalled and costs to increase.

As discussed above, the Systems Program Office has changed the technical specifications to allow the contractor to modify Category 1 software with government approval. This change will help clarify the contractor's responsibility for AWIPS.

B. NWS software development organizations lack adequate software engineering skills.

NWS software development personnel are primarily meteorologists and hydrologists. They generally lack formal education and training in software engineering, and are performing the software development as a result of their in-depth scientific knowledge and their familiarity with NWS operations. The NWS has a longstanding history of developing software for proof-of-concept and prototyping of advanced hydrometeorological capabilities. This is important and appropriate work whose results provide valuable input into understanding and specifying requirements. However, the AWIPS software itself must be highly reliable, maintainable, flexible, and portable, as well as amenable to enhancement and change. Development of large production-quality software systems requires both sophisticated software engineering knowledge and experience, and software engineering process discipline.

Our discussions with NWS personnel indicated a lack of appreciation for such issues. For example, one senior manager expressly stated that most of his software developers were not professional programmers, that he would not hire software engineers, and that he would not provide his staff with extensive software engineering training, although software engineering capabilities would be available through support contractors. We do not view software engineering as a support function; rather, software engineers need to provide direction to the software development team in implementation of requirements.

The NWS should apply its knowledge of NWS operations and services, and the information it gains from its proof-of-concept and prototyping activities to the specification of requirements for hydrometeorological applications (i.e., to development of the Technique Specification Packages), which should then be furnished to the contractor for proper engineering and implementation.

Since the release of our draft inspection report, we visited the Office of Oceanic and Atmospheric Research Forecast Systems Laboratory in Boulder, Colorado. We received briefings on the history of the Denver AWIPS Risk Reduction and Requirements Evaluation (DAR³E) system, the Profiler Program, and other prototype development activities. Forecast Systems Laboratory personnel demonstrated the DAR³E system and provided us an opportunity to use the system. We also visited the Denver Weather Service Forecast Office and witnessed the operational use of the DAR³E system.

Managers of the Forecast Systems Laboratory indicated that the DAR³E development team consisted of NOAA meteorologists and contractor software engineers. Both government and contractor development personnel were provided with software development training to enhance their technical skills. DAR³E was designed and implemented using a structured software development approach including the delivery of software design and user documentation. Configuration management controls and problem trouble reporting procedures were established and used to help manage the development and maintenance activities.

We found that the software development approach used by the Forecast Systems Laboratory is well-suited for the development of prototype software. We also found that the DAR³E system is valuable in providing NOAA with a prototype of the AWIPS workstation environment, and the project has been successful as a risk reduction activity.

Also since the release of the draft inspection report, we examined software developed by the NWS that will be furnished to the contractor as Category I code. We analyzed the degree of maintainability and understandability, and looked for such characteristics as modularity, variable localization, minimal coupling, control flow complexity, and in-line documentation. We found that the quality of the NWS software varied considerably. While some was production-quality code, other code should be substantially re-engineered or redeveloped altogether before inclusion in an operational AWIPS environment.

C. Government software development places an excessive management burden on the Systems Program Office.

Software development for AWIPS is being performed by the NWS in several organizations. River Forecast Center software is developed primarily in the Office of Hydrology. Weather Forecast Office software is developed primarily in the Office of Systems Development Techniques Development Laboratory and Integrated Systems Laboratory. The Systems Program Office has no formal authority over the software development activities of these organizations and therefore lacks the controls essential

to effective management. In add tion, the Systems Program Office is presently understaffed for its current responsibilities. Consequently, an already overcommitted Systems Program Office will be faced with the responsibility of managing a critical major system acquisition contract, while simultaneously ensuring—without adequate authority—that the NWS software development efforts yield production-quality software.

For the re-baselining strategy to succeed as planned, the Systems Program Office, NWS, and contractor must agree on numerous important issues with respect to government software including:

- Procedures for contractor acceptance of the software
- Documentation needed by the contractor for software maintenance
- Coding and quality standards
- The process by which the government will gain a detailed understanding of the contractor's system software

Systems Program Office and NWS representatives are aware that agreements must be negotiated with the contractor, but the specific topics and details that these agreements must cover have not yet been determined.

If NWS continues to develop software to be furnished to the contractor, the Systems Program Office should provide the same oversight of NWS software development organizations as is desirable when any large software-intensive system is being acquired. Oversight would involve, as early as possible, requiring NWS to provide a detailed software development plan. This plan should present such information as: (1) the NWS's software analysis and design methodologies, (2) test plans and test procedures, (3) plans and procedures for internal inspections and reviews, (4) plans and procedures for external reviews, (5) content of requirements, design, and maintenance documents, and (6) the tracking system and management indicators that will be used to allow early identification of schedule overruns and technical performance issues. The Systems Program Office should review and approve this information, review all products and documentation, and conduct periodic progress reviews and audits.

Such planning is not currently conducted by NWS for software development, nor are the Systems Program Office's plans for oversight defined, although the latter has indicated that it may use an Independent Verification and Validation (IV&V) contractor for assistance. The Systems Program Office is aware that certain agreements must be negotiated with the NWS to help ensure that its own and the

contractor's expectations concerning software products, documentation, and schedules are met, but the topics and details have not been determined. The difficulty of reaching and enforcing agreements in the absence of formal authority over NWS software development organizations should not be underestimated.

For management control and accountability, it is essential that one government organization have the responsibility and authority for managing the AWIPS program, and this organization should be the Systems Program Office. This position is fully consistent with the justification for creating the Systems Program Office which was "...to strengthen the program management by assigning full responsibility for the design, procurement, and acceptance of new systems to a single management office reporting directly to the highest executive levels of NOAA." The Systems Program Office cannot be expected to carry out its responsibilities for AWIPS successfully if it lacks authority over organizations on which it must depend for the delivery of important software capabilities. It simply is not sound management practice to allow a program of the size, complexity, and importance of AWIPS to be a shared responsibility.

In its response, NOAA indicated that the Systems Program Office and NWS will develop standards to guide in-house software development and documentation. This partially address the concerns described above. We do not believe that the Systems Program Office has the authority or the resources to ensure that the software to be furnished to the contractor is of production quality. Therefore, the Systems Program Office should be prepared to accept any reasonable improvements that the contractor may want to make to the government-furnished software.

IV. **The AWIPS request for proposal is poorly drafted and will not serve as the basis for an effective contract.**

The request for proposal forms the basis for the AWIPS contract for development, deployment, operations, and maintenance. This contract must be clear, consistent, unambiguous, and enforceable since it is the instrument for determining the rights and obligations of the contractor, and the responsibilities of the government. As such, it will be referred to continually by both parties to determine requirements and resolve disagreements. Our review of the AWIPS request for proposal revealed that it is poorly organized, contains redundant and superfluous information, and presents ambiguous and possibly contradictory requirements. The request for proposal should be reviewed and streamlined prior to contract award.

Fundamental management principles, systems engineering practice, and the Federal Acquisition Regulations (FAR) guide the formation of contracts for major system acquisitions. The foregoing dictate that the contract be organized to ensure that all requirements of a similar type are present and fully specified. For example, system technical requirements should be separated from contractor work tasks, and instructions for invoicing should be separated from the identification of contract line items and their prices. The contract should facilitate the presentation of a complete and consistent set of technical, management, and legal requirements. Applying these principles, all *system* technical requirements should be placed in technical specifications, while all requirements for *contractor* technical and management efforts should be placed in the statement of work. All requirements not associated with the technical aspects of the system or the contractor's performance of direct technical or management efforts should be placed in other sections of the request for proposal as prescribed by the Uniform Contract Format (FAR Section 14.201).

Dispersion of heterogenous requirements throughout a complex major system acquisition contract, as is done in the AWIPS request for proposal, makes it difficult to determine: (1) if the system technical requirements are completely specified, (2) if the contractually-required technical and management tasks will produce the desired results, and (3) if the additional requirements for doing business with the government are appropriate and complete. It also makes it difficult to determine if there are ambiguous and conflicting requirements in the different parts of the request for proposal.

The Uniform Contract Format was inappropriately used to develop the request for proposal. For example, Section B is intended to provide a *brief* description of the supplies or services and their quantities, but the AWIPS request for proposal fails to do so. Instead, Section B comprises extraneous information including the acquisition strategy; a partial discussion of data rights; the cost breakdown structure; and detailed billing instructions, including a discussion of payment terms.

Section C of the request for proposal, Description/specifications, contains the AWIPS statement of work, as it should. However, the statement of work is inadequate. It does not clearly and sharply specify the technical and management work efforts required of the contractor, and it contains requirements or parts of requirements that belong in other sections. Examples of appropriate provisions of the statement of work would be requirements for the contractor to perform system design, development, assembly/integration, installation, testing, fielding, and site activation, as well as to develop and implement logistics and training programs, support reviews and audits, and implement program controls. To the extent that the proper requirements are present in the statement of work, many are not stated in such a way as to clearly obligate the contractor to perform work. Rather, the statement of work states throughout that certain work is required, but does not specifically state that the contractor shall perform this work, leaving unclear precisely what the contractor's obligations are.

In addition, appropriate statement of work requirements are obscured by the myriad of misplaced requirements and extraneous information. A few examples of misplaced requirements are:

- Instructions for proposal preparation (e.g., Section C.3.1.1., Amended Proposal Responses), which properly belong in Section L, Instructions, conditions, and notices to bidders.

- Documentation requirements (e.g., Section C.3.1.22, Performance and Availability Reports), which properly belong in data item descriptions.

- Special contract provisions (e.g., Section C.3.1., "...the contractor shall provide...an office, telephones, and parking spaces for two government representatives."), which properly belong in Section H, Special contract requirements.

- Requirements for deliverable contract data (e.g., Section C.3.2.1.4, "...the contractor shall provide a quarterly report of controlled assemblies..."), which properly belong in a contract data requirements list.

- Identification of government-furnished information (e.g., Section C.3.1.4.1, Government Furnished Information (GFI) in Support of Pre-MARD Site Surveys), which properly belongs in Section H.

We pointed out in our draft report that the request for proposal failed to present a consolidated list of government-furnished equipment, information, and software; a uniform means of specifying document formats; or a uniform means of specifying requirements for deliverable data. Requirements are fragmented and repeated. For example, escrow provisions are incorrectly placed in Sections C.3.1.28, C.3.1.29, and C.3.1.30 and then partially repeated and expanded upon in Section H.25. Similarly, Section C.3.1.20 discusses the government's right to alter the deployment schedule, with these and related requirements presented in Section F.6.

At the time of our inspection, Sections C.3.2.1.5 and C.3.3.1.4 set forth requirements for software development efforts which were inconsistent with the cost breakdown structure in Section B. The former sections stated that the contractor shall provide software development and integration as a cost plus incentive fee effort for deployment and operations, respectively, while the cost breakdown structure identified this work as cost plus incentive fee or fixed price incentive fee depending on the specific circumstances." The specific circumstances were not described. Concurrent cost plus and fixed price software efforts raise the potential for confusion as to which contract type work is properly charged. Inappropriate charging of fixed price software development work as cost plus work occurred on NEXRAD because of a similar contract structure.

The misunderstanding of the parts of the Uniform Contract Format and the lack of discipline in drafting the request for proposal, if not corrected, creates an unacceptable risk of a contract that is difficult to administer and enforce, and to disputes that will be difficult, if not impossible, to resolve. The AWIPS program is too large, complex, and critical to depend on the good faith of the parties to compensate for the risks inherent in a poorly drafted contract.

The Systems Program Office convened a team to review and revise the solicitation. The team agreed to: (1) remove the ambiguity about whether software development is cost plus or fixed price, (2) place several items related to contract administration and special contract provisions in the appropriate sections, and (3) prepare a consolidated listing of government-furnished information. These are improvements; however, in our view, the request for proposal still has substantial problems.

RECOMMENDATIONS

Presented below are our recommendations, a synopsis of NOAA's response, and our comments on NOAA's response. Because NOAA addressed Recommendations #1 and #2 together, they are both discussed after Recommendation #2.

We recommend that the Under Secretary and Administrator of NOAA require the following actions.

RECOMMENDATION #1

The NWS should present a nontechnical description of the selected hydrometeorological applications and the rationale for why particular applications are allocated to the new AWIPS milestones (i.e., First Article and first Pre-planned Product Improvement). The NWS should explain why the applications selected for the First Article represent the minimum requirements needed for initial installations and should prioritize the additional functions for the first Pre-planned Product Improvement. The NWS should identify those applications that (1) allow release of AFOS units, (2) permit enhanced service, and (3) reduce staff effort or staffing levels.

RECOMMENDATION #2

The Systems Program Office should use the information developed from Recommendation #1 for the selection of applications for the First Article and the prioritization provided for the first Pre-planned Product Improvement applications to make a final determination of applications to be delivered by the contractor for each AWIPS milestone.

Synopsis of NOAA's Response

NOAA objected to providing nontechnical descriptions of the selected applications and their rationale. NOAA stated that providing this information would displace the requirements decisions from the experts in this area. NOAA also pointed out that the Systems Program Office's responsibility is to translate established requirements into engineering terms for intelligent and expeditious acquisition of new systems.

OIG Comments

Without additional information on requirements, we cannot be confident that they have been allocated to software builds appropriately. We do not question NOAA's expertise in hydrological and meteorological analysis and forecasting techniques, nor do we question the utility of the AWIPS applications for weather forecasting operations or the effectiveness of the algorithms. Rather, our concern is with their *management*. The management of major system acquisition programs, particularly those that are software intensive, requires a level of management experience and knowledge that has not been demonstrated on AWIPS.

AWIPS has already experienced considerable delay and cost growth. AFOS is antiquated and difficult to maintain. It is imperative that the initial capabilities fielded for AWIPS allow the release of AFOS units as soon as possible. We strongly support Dr. Joseph Shea's recommendation that the equivalent of AFOS capability be provided by the second software build,[14] if this is feasible from technical and management perspectives. To date, however, NOAA has not provided the information to identify the specific applications that will allow release of AFOS units. In addition, AWIPS program officials have indicated that under the new schedule, AFOS units cannot be released until the third build. This build is to be completed nine months after the second build.

To provide a common understanding of what is actually being planned for AWIPS, NOAA should identify what the specific applications are that permit the release of AFOS units. NOAA should explain whether the second software build will allow release of AFOS units. If the second build does not accomplish this objective, NOAA should explain why it does not, present the schedule by which the necessary capabilities will be in place, and provide the rationale for that schedule.

We strongly disagree with NOAA's position on the Systems Program Office's role with respect to requirements. The Systems Program Office has significant responsibilities in addition to translating established requirements into engineering terms for acquisition of new systems. The Systems Program Office must be concerned with risk, feasibility, cost,

[14]Letter from Dr. Joseph F. Shea, Adjunct Professor, Department of Aeronautics and Astronautics, Massachusetts Institute of Technology to Mr. Raymond Kammer, Assistant Deputy Secretary for Oceans and Atmosphere, March 30, 1992, p.3.

schedule, and contractual issues on AWIPS, and the order of requirements implementation is relevant to all these issues. The Systems Program Office is responsible for carrying out its acquisition mission in a way that ensures that Department of Commerce objectives are being satisfied. If the Systems Program Office does not ensure that the order of requirements implementation is appropriate from management, engineering, contractual, and policy perspectives—with the earliest possible release of AFOS units being a priority—it is failing a critical management responsibility.

RECOMMENDATION #3

a. Any government-developed software that is provided to the contractor should be for information only, and its use should not be mandated. The Systems Program Office should eliminate Category 1 software and revise the request for proposal accordingly. To the extent the contractor chooses to use government-developed software, the contractor should not be restricted from making any changes necessary to satisfy functionality, performance, or quality requirements.

b. The Systems Program Office should re-baseline AWIPS and revise the AWIPS contract based on the approach that use of government-developed software will not be mandated.

RECOMMENDATION #3 (Alternate)

If the use of government-developed software continues to be mandated and the contractor continues to be restricted in its modification, NOAA should operate and maintain AWIPS, and the contract option for this work should be deleted.

Synopsis of NOAA's Response

NOAA responded that it does not intend to mandate the use of NOAA-developed software, acknowledged that this area is ambiguous in the request for proposal, and indicated that the request for proposal would be clarified.

OIG Comments

The Systems Program Office has changed the technical specifications to allow the contractor to modify Category 1 software with government approval. It has also inserted a contract clause giving total system responsibility to the contractor. Although these items are improvements, they still fall short of our recommendation of giving full latitude to the contractor in implementing AWIPS software.

RECOMMENDATION #4

If NOAA chooses to operate and maintain AWIPS:

(a) The NWS software development and maintenance organizations should be required to establish a defined and managed software engineering process, and to acquire the personnel, education, and training necessary to accomplish this.

(b) NOAA should give the Systems Program Office formal authority over NWS software development organizations similar to the authority that it will exercise over its AWIPS contractor. NOAA should also provide the Systems Program Office with adequate resources to monitor the activities and results of several software development organizations.

(c) Contractual documentation requirements should be reviewed and improved to ensure that the government receives adequate information to operate and maintain AWIPS.

Synopsis of NOAA's Response

NOAA responded that it does not choose to operate and maintain AWIPS. NOAA indicated that the Systems Program Office and NWS will be developing standards to guide in-house software development and to establish the content of materials that will be furnished to the AWIPS contractor.

OIG Comments

While standards are needed, it should be noted that the software and documentation being furnished to the contractor for the initial software builds have been developed without these standards. The NWS is planning to provide end-product software for contractor integration into future builds (i.e., for pre-planned product improvements), and this software should be of production quality. However, we see no provisions being made for enforcing these standards and for educating government software development personnel in their use. Finally, although the Systems Program Office is responsible for managing the development and deployment of AWIPS, it lacks the resources and authority to monitor the activities and results of the NWS software development organizations.

RECOMMENDATION #5

The Systems Program Office should assemble and lead a team of senior personnel from the Systems Program Office, NWS, Office of Procurement Services, and Office of Counsel to review and revise the AWIPS request for proposal prior to contract negotiations, with the objective of obtaining a clear, consistent, and enforceable contract. This office stands ready to assist in this review if we can be of help.

This revision should not negatively affect the offerors' proposals or the Systems Program Office's plans since only repetitions, ambiguities, contradictions, and omissions will be identified and corrected; the intent of the contract will not change.

Synopsis of NOAA's Comments

NOAA said that it agrees with this recommendation, and that the Systems Program Office Director is taking steps to clear up the remaining ambiguities.

OIG Comments

The steps that have been taken to revise the request for proposal have yielded some improvements, but in our view, the solicitation still has substantial problems. The Systems Program Office assembled a team to review and revise the request for proposal based on our recommendation. However, the team was led by the same personnel responsible for the preparation of the original solicitation and did not contain senior-level members with credible experience in the contractual, management, and technical issues of major system acquisitions. We objected to the composition of the team and suggested an alternative, which was rejected. The steps taken by the team to improve the solicitation, as documented in the memorandum that it prepared, indicates a serious failure to grasp important issues raised in our draft report.[15] The team made several improvements, but the fundamental problems that we raised have not been resolved.

The team agreed to take the following actions: (1) remove the ambiguity about whether software development is cost plus or fixed price, (2) place several items related to contract administration and special contract provisions in the appropriate sections, and (3) prepare a consolidated listing of government-furnished information.

The team rejected the need for restructuring the request for proposal, removing redundancy, having contract line items, more clearly defining the technical and management work efforts, and incorporating documentation requirements in an orderly way. The team stated that redundancy was in the solicitation at the contracting officer's professional discretion to protect the government's interests.[16] With regard to the contractor's responsibilities, the team observed that since the request for proposal uses the term *shall* over 1700 times and there are some additional references to the term *must*, the contractor's obligations are

[15]Memorandum from Andris Karlsons, Chief, SPO Procurement Staff to Frank DeGeorge, Inspector General, *Solicitation Concerns within Draft Inspection Report on AWIPS Re-Baselining and Associated Issues*, April 1, 1992.

[16]Memorandum from Karlsons to DeGeorge, p.3.

"thereby heavily emphasized and clearly defined."[17] The team's rejection of the need for an orderly approach to specifying documentation requirements was based on the view that AWIPS hardware and software systems are primarily "off-the-shelf" items.[18] We find this perspective puzzling inasmuch as AWIPS will contain approximately one million lines of newly-developed source code.

Throughout our inspection senior AWIPS program office personnel have taken the position that it is futile to try to eliminate ambiguities now since there are always problems of interpretation in major system acquisition contracts. In response to our concern that certain key requirements are missing from the statement of work (e.g., for software development and configuration management practices), AWIPS officials told us that the offeror's plans and proposals comprise those requirements and will be contractually binding for the winner upon contract award. They also told us that although the solicitation may have deficiencies, the program office has been working with the two contractors for several years, and the contractors know what the government wants.

In our opinion, redundancy and ambiguity should be eliminated as much as possible. We believe they provide the opportunity for claims, disputes, and mistakes, and they make the contract difficult to track, monitor, and enforce. We are troubled by the over-reliance of the Systems Program Office on the good will and understanding of the contractor. Over-reliance could be avoided by a clear and complete contract. We are also troubled by the reliance placed on the contractors to establish requirements through their proposals, rather than the government's taking responsibility for this in the statement of work.

We brought these problems to the attention of the Systems Program Office over two months ago, and their response was to convene the team described above. The Systems Program Office now acknowledges that we have identified serious problems, but believes that any additional corrections would take too much time, since their objective is to award the contract as quickly as possible. We disagree with this approach and believe that the Systems Program Office is taking an unnecessarily risky course of action. Since NOAA does not plan to award the AWIPS contract until the end of 1992, we believe there is still time to make the modifications necessary to obtain a clear and enforceable contract.

[17]Memorandum from Karlsons to DeGeorge, Enclosure, p.4.

[18]Memorandum from Karlsons to DeGeorge, Enclosure, p.5.

ATTACHMENT

UNITED STATES DEPARTMENT OF COMMERCE
The Deputy Under Secretary for
Oceans and Atmosphere
Washington D.C. 20230

MAR 19 1992

MEMORANDUM FOR: Frank DeGeorge
Inspector General

FROM: Ray Kammer

SUBJECT: Draft Inspection Report on AWIPS Reaselining and associated issues (Report No. SED-4585-2-0001)

Thank you for the opportunity to review the subject report. We appreciate your submitting it during the current phase of AWIPS planning. The Report points out several areas where rethinking and clarification of our plans are needed. We will take action accordingly.

Here are my reactions to the Report's five recommendations:

> Recommendation 1: (NWS should present non-technical descriptions, rationale, and prioritization of hydrometeorological applications needed for various stages of AWIPS deployment, including first article test and initial pre-planned product improvement.)
>
> and,
>
> Recommendation 1: (The NOAA Systems Program Office should use information from Recommendation 1 to determine which applications should be delivered by the contractor for each AWIPS milestone.)

I am reluctant to provide "...a non-technical description of the selected hydrometeorological applications and a rationale..." that would then be used for decision making. The effect of this would be to displace the requirements decisions from the people who are best qualified to make them to people whose strengths lie in other areas. "Non-technical description(s)" would discard the very information that is necessary to make these highly technical decisions.

Applications destined for AWIPS have been selected to be of maximum utility to weather forecasting operations using proven algorithms. The long history of applications development and refinement in NOAA is proven effective every day at the National Meteorological Center, at field forecast offices, and most recently at the Norman and Denver Risk Reduction sites.

Expertise in hydrological and meteorological analysis and forecasting techniques resides in NOAA's National Weather Service and the Forecast Systems Laboratory of NOAA's Office of Oceanic and Atmospheric Research. We will continue to rely on this in-house expertise to set requirements and develop algorithms for forecasting. We will also continue to rely on the NOAA SPO to translate established requirements into engineering terms for intelligent and expeditious acquisition of new systems.

> Recommendation 3: (Any government-developed software provided to the contractor should be for information only, and its use should not be mandated. The SPO should revise the contract based on this approach accordingly.)

We do not intend to mandate the use of NOAA-developed applications software by the AWIPS contractor. We do require that the hydrometeorological algorithms the software embodies be preserved. Furthermore, we will encourage algorithm improvement if the contractor demonstrates expertise in specific hydrometeorological techniques. This area is ambiguous in the current RFP and it will be clarified.

> Recommendation 4: (If NOAA chooses to operate and maintain AWIPS...)

In light of our response to Recommendation 3, NOAA would not choose to operate and maintain AWIPS. However, one specific recommendation regarding software management (Recommendation 4a demands attention: The NOAA SPO and NWS will be developing an appropriate set of standards to guide in-house software development and to establish the content of the materials (i.e., code and documentation) that will be furnished to the AWIPS contractor. Software change management for the existing AFOS network is tightly controlled at NWS. This process should become far easier on AWIPS' technologically-superior operating platforms.

> Recommendation 5: (The NOAA SPO should assemble a team to revise the AWIPS RFP to ensure that it will serve as an enforceable contract document.)

We agree with this recommendation. Mr. Robert Valone, Director of the NOAA SPO, is already taking steps to clear up the remaining ambiguities.

Appendix III

U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE
SUITE 2320 RAYBURN HOUSE OFFICE BUILDING
WASHINGTON, DC 20515–6301
(202) 225–6371
Internet: SCIENCE@HR.HOUSE.GOV

January 31, 1996

The Honorable Ronald H. Brown
Secretary
Department of Commerce
14th Street and Constitution Avenue, NW
Washington, DC 20230

Dear Secretary Brown:

I am deeply concerned by recent reports in the *Los Angeles Times* and from other sources that the National Oceanic and Atmospheric Administration (NOAA) exceeded its travel budget by more than eighty percent in fiscal year (FY) 1994, used its budget to furnish security for your travel, supplied faulty data to Congress on the true extent of its travel overruns, and failed to police the misuse of credit cards issued solely for official government purposes.

In order to ascertain the validity, if any, of these damaging reports, I would request that you provide the Committee on Science of the House of Representatives the following information by no later than February 14, 1996:

1. a detailed explanation of why NOAA exceeded its travel budget by 73% in FY 1993 and 84% in FY 1994. Please specify which NOAA programs were cut to make up these travel cost overruns.

2. a list of all overseas trips paid for, in part or in whole, by NOAA in FY 1993, FY 1994, FY 1995 and to date in FY 1996. Please include a complete list of the overseas destinations, cost of each trip, whether the trip was primarily in support of a NOAA mission or in support of other Department of Commerce functions, number of individuals traveling at NOAA's expense, name and title of each individual traveling, and brief description of the purpose of the travel.

3. a list of any non-federal employees who have traveled at NOAA's expense (including reimbursable expenses) in FY 1993, FY 1994, FY 1995, and to date in FY 1996. This information should include the individual's title, destination, total travel cost, purpose of the travel, and whether the federal government has been reimbursed for the expense.

4. a detailed accounting of all NOAA funding used to supplement your travel budget, including any monies used to defray the cost of security. Please include details of each trip where NOAA funds were used, a detailed list of all expenses paid by NOAA, a complete list of all individuals traveling with you, and information on the connection between the trip and NOAA's mission.

5. an explanation of the apparent discrepancy in NOAA's FY 1996 Budget Estimate (Congressional submission); in the FY 1996 Budget Estimate, under object class 21 "Travel and transportation of persons", NOAA's "actual" travel expenditure for FY1994 is listed as $27,944,000; this figure is substantially below the $34,880,739.30 travel total disclosed in the Commerce Department Office of Inspector General's September 1995 Final Audit Report (EAD-7129-5-0001).

6. a list of all Commerce personnel authorized to carry a government travel charge card, including their title, general schedule grade, brief job description, and a breakdown (by office) of where each card-holding employee works.

7. the criteria used to evaluate which Commerce employees require a travel charge card.

Thank you for your attention to this important matter. I look forward to hearing from you promptly.

Cordially,

Robert S. Walker
Chairman

RSW:rmr

cc: The Honorable George E. Brown, Jr.
Dr. D. James Baker

UNITED STATES DEPARTMENT OF COMMERCE
The Assistant Secretary for Legislative and Intergovernmental Affairs
Washington, D.C. 20230

FEB 27 1996

The Honorable Robert S. Walker
Chairman, Committee on Science
House of Representatives
Washington, D.C. 20515-6301

Dear Mr. Chairman:

The Department welcomes the opportunity to respond to your inquiry concerning allegations made in The Los Angeles Times regarding the National Oceanic and Atmospheric Administration (NOAA) and its management of its travel budget and other resources. Enclosed is the response prepared by NOAA to the questions posed by your letter dated January 31, 1996.

I understand that every effort was made to respond to your request completely. However, questions (3) and (6) are incomplete because data to answer them fully is not readily available. In these cases, the Department will provide you with the following information by Friday, March 22:

(3) A list containing the name, position title, grade and organization of NOAA employees who traveled in FY 1993 and FY 1994.

(6) A list of DOC employees who are authorized to carry the American Express card (We have already provided a list of NOAA employees authorized to carry the American Express card). Also, a list containing the name, position title, grade and organization of current DOC cardholders.

If you have any questions, please call me at (202) 482-3663 or contact William Taylor, Counselor to the Secretary, at (202) 482-5485.

Sincerely,

Jane Bobbitt

Jane Bobbitt
Assistant Secretary for Legislative
and Intergovernmental Affairs

Enclosure

cc: The Honorable George E. Brown, Jr.

National Oceanic and Atmospheric Administration
U. S. Department of Commerce Response
to
Robert Walker's Questions regarding Secretarial Travel

Following are detailed responses to each of the issues that your letter raises:

1. Provide a detailed explanation of why the National Oceanic and Atmospheric Administration (NOAA) exceeded its travel budget by 73 percent in FY 1993 and 84 percent in FY 1994. Please specify which NOAA programs were cut to make up these travel cost overruns.

NOAA did not exceed its travel budget by 73 percent in FY 1993 and 84 percent in FY 1994. In comparing the travel estimates to the actual obligations, data from the President's budgets were used for the Operations, Research and Facilities accounts for NOAA.

	Budget Estimates (thousands)	Expenditures (thousands)	Difference (thousands)
FY 1993	$18,603	$22,454	$3,851
FY 1994	$18,707	$27,944	$9,237

There were differences between the budget estimates for travel and actual obligations since unanticipated travel to further program goals or for emergencies can increase travel expenditures in a given year. A recent example would be the increased travel required to respond to the January 19, 1996, Rhode Island oil spill. These differences do not reflect a cut to NOAA programs; rather they reflect a reordering of expenditures based on changed circumstances. There are variances in all categories of spending (e.g., salaries, grants, supplies). Since 1994, NOAA has improved the accuracy of travel estimates by establishing a consultative mechanism that includes representatives from each of the operating entities within NOAA. In prior years, travel estimates were calculated centrally using actual obligation data from eighteen months prior to the fiscal year. This previous technique did not take into account future program changes that would affect travel, like the ramp-up in the National Weather Service modernization program in the FY 1994 timeframe.

2. Provide a list of all overseas trips paid for, in part or in whole, by NOAA in FY 1993, FY 1994, FY 1995 and to date in FY 1996. Include a complete list of the overseas destinations, cost of each trip, whether the trip was primarily in support of a NOAA mission or in support of other Department of Commerce (DOC) functions, number of individuals traveling at NOAA's expense, name and title of each individual traveling, and brief description of the purpose of the travel.

Enclosed is a list of all foreign travel paid for by NOAA in FY 1993, 1994, 1995 and to date in FY 1996 (Enclosure 1). This report contains the date of travel, individual traveling, and cost of travel. The data base containing NOAA's travel history is used to record financial transactions. It does not contain information on position title, purpose of travel, destination or whether or not the trip was in support of NOAA or other DOC functions. This information can only be obtained by a manual search of approximately 7000 foreign travel orders/vouchers.

Enclosed is a Master List of all current (1995) NOAA employees who travel ed in FY 1995 and through February 1996, containing name, position title, grade, and organization (Enclosure 2) which can be used as a cross-reference for additional information concerning foreign travel. We have requested personnel information on employees for FY 1993-FY 1994 from the National Finance Center and will forward the report upon receipt.

3. Provide a list of any non-federal employees who have traveled at NOAA's expense (including reimbursable expenses) in FY 1993, FY 1994, FY 1995, and to date in FY 1996. This information should include the individual's title, destination, total travel cost, purpose of the travel, and whether the Federal Government has been reimbursed for the expense.

Enclosed is a list of non-federal individuals who traveled at NOAA's expense in FY 1993, 1994, 1995 and to date in FY 1996 (Enclosure 3A). Again, the list does not contain information on position title, purpose of travel, destination or whether or not the trip was in support of NOAA or other DOC functions. The only method to capture this information would be to pull approximately 3000 individual travel orders/vouchers from existing files. Enclosure 3B provides a list of those individuals who have traveled at NOAA's expense and who have not reimbursed the government for outstanding travel advances. This list does not, in and of itself, identify the existence of a debt. It identifies a travel advance that may not have been administratively cleared. The actions necessary to clear advances may be either the filing of a voucher which directs that any reimbursement be used to offset an outstanding advance or the direct repayment of the advance.

4. Provide a detailed accounting of all NOAA funding used to supplement your travel budget, including any monies used to defray the cost of security. Please include details of each trip where NOAA funds were used, a detailed list of all expenses paid by NOAA, a complete list of all individuals traveling with you, and information on the connection between the trip and NOAA's mission.

A review of the travel history of the Secretary of Commerce and the DOC security personnel shows that no NOAA funds were used to pay travel costs for these individuals or the Secretary.

5. Provide an explanation of the apparent discrepancy in NOAA's FY 1996 budget estimate (Congressional submission); in the FY 1996 Budget Estimate, under object class 21 "Travel and transportation of persons", NOAA's "actual" travel expenditure for FY 1994 is listed as $27,944,000; this figure is substantially below the $34,880,739.30 travel total disclosed in the Commerce Department Office of Inspector General's September 1995 Final Audit Report (EAD-7129-5-0001).

The apparent discrepancy between the amount of FY 1994 travel expenditures stated in the Department of Commerce Office of Inspector General's September 1995 Final Audit Report and NOAA's actual travel expenditures for FY 1994 results from the Office of Inspector General's use of the Financial Services Division Travel Disbursement by Sub-object Class Report. This report is not a financial report and includes amounts which are non-travel costs such as movement of people (change of duty moves) and temporary quarters.

A review of NOAA's financial records (SF-225) reveals that the $27,944,000 reported in the budget appendix as actual travel obligations reportable against the OR&F appropriation account, is correct.

6. Provide a list of all Commerce personnel authorized to carry a government travel charge card, including their title (General Schedule grade, brief job description, and a breakdown (by office) of where each cardholding employee works.

Enclosure 4 is the NOAA Master Cardholder Listing Report from American Express as of December 15, 1995. This list provides the names of 7,173 NOAA cardholders, office, billing address, phone numbers, and status of the issued cards. Information on title and grade of NOAA employees who travelled in FY 1995 and through February 1996, can be obtained from the Master List of NOAA employees (Enclosure 2). The DOC has requested American Express to provide a listing of all DOC cardholders and will provide it to the Committee upon receipt.

7. Provide the criteria used to evaluate which Commerce employees require a travel charge card.

Current regulations state that frequent travelers (defined as an employee expected to travel on behalf of the Department two or more times per year) should apply for a Government charge card. The published criteria for travel charge cards is Enclosure 5.

Enclosures

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Washington, D C 20230
OFFICE OF LEGISLATIVE AFFAIRS

AUG 16 1996

RECEIVED
AUG 20 1996
Committee on Science

The Honorable Robert Walker
Chairman
Committee on Science
U.S. House of Representatives
Washington, D.C. 20515

Dear Mr. Chairman:

Enclosed are the National Oceanic and Atmospheric Administration's responses to questions regarding NOAA travel raised at the February 29, 1996 hearing on National Weather Service Modernization.

Please do not hesitate to call me should you require additional information.

Sincerely,

Brian Wheeler
Director

Enclosure

QUESTION

I requested information from the National Oceanic and Atmospheric Administration (NOAA) about cost overruns in travel in FY 1994. The response I got back was that the Inspector General (IG) report was wrong and that NOAA had exceeded the budget by only 50 percent, instead of 84 percent as had previously been indicated by the IG. That still seems to be a rather large overrun. Is that something which is being addressed at this point by the Agency? (Lines 1028-1034)

ANSWER

NOAA believed that the NOAA travel obligations were misstated in Audit Report No. EAD-7129-5-0001/September 1995. NOAA hired a contractor, KPMG Peat Marwick, to review and make a determination on the correctness of the source of data the IG used for its analysis. The contractor substantiated that the IG used a data base which inadequately portrayed NOAA's travel obligations. The contractor supported NOAA's view that the financial report NOAA recommended for the purpose of identifying NOAA's travel obligations was correct. A copy of the findings were provided to your office on June 14, 1996.

In reviewing the history of travel estimates for the Operations, Research and Facilities (OR&F) account, NOAA found that the budget for travel prepared for FY 1994 was formulaic, not programmatic for what would be spent in that year. The travel estimate that was used in the President's Request was based solely on FY 1991 expenditures (the budget cycle for FY 1994 began in FY 1992). Initially, the President's Request to Congress for FY 1994 estimated $18.707 million for travel in OR&F. Later, in the NOAA Justification to Congress, this estimate was increased to $20.601 million to account for some adjustments to base.

In the event OR&F travel at the end of FY 1994, which was fully justified for programmatic reasons, totaled $27.895 million. This amount exceeded the NOAA Justification by $7.294 million, or 35 percent above the $20.601 figure. Additionally, NOAA expended for travel $8.3 million in reimbursable funds and $0.93 million from non-OR&F accounts. Most of the increase in OR&F travel spending in excess of the estimate of $20.601 million, or $7 million, lay in three activities. These are the National Weather Service (NWS), the National Marine Fisheries Service (NMFS), and the National Ocean Service (NOS). These three activities accounted for $215.6 million of the $275.8 million increase in OR&F received in FY 1994 compared to FY 1991, the year used as the basis for estimating OR&F travel. As noted above, this increase in programmatic funding was not taken into consideration when estimating FY 1994 travel. The funds spent in travel in excess of the estimate were required to execute the increased FY 1994 OR&F appropriation.

NOAA is now preparing its travel budget in a programmatic fashion, soliciting the views of NOAA's activities and incorporating programmatic needs. This course will result in a better correlation between estimates and reports on actual spending.

QUESTION

The IG was evidently sent a memorandum from NOAA on January 31, 1995, indicating that the total travel expenses were actually $37.125 million. Now, that's a figure that is very high, in our view. It's a figure that this committee was never informed about. And it would even seem to exceed the $34.8 million figure that the IG had referenced in his report. Can you give us some explanation for that? (Lines 1080-1087)

ANSWER

The IG incorrectly reported that NOAA overspent its travel budget by 84 percent. In the President's Request to Congress for FY 1994, OR&F travel was estimated at $18.707 million and was later increased to $20.601 million in NOAA's Justification. Actual OR&F travel for FY 1994 totaled $27.895 million, not $34.8 million as reported by the IG. This amount surpassed the estimate by $7 million, or 35 percent. An independent auditor, KPMG, confirms NOAA used the correct data for reporting travel obligations. Additionally, FY 1994 NOAA travel obligations included $8.3 million in reimbursable funds and $0.93 million from non-OR&F accounts. These figures total the $37.125 that NOAA previously indicated it spent for travel in FY 1994.

QUESTION

Dr. Baker suggested that the unforeseen travel expenses that were overruns were because of the NWS Modernization Program and that most of the extra travel was related to the modernization program. Explain how that could be since the modernization program has been underway for some time. (Lines 1091-1101)

ANSWER

Dr. Baker indicated that the NWS Modernization Program was partially responsible for the programmatic costs in FY 1994. NWS exceeded the estimate in the NOAA Justification to a greater extent than NOAA's other activities. Of the OR&F funds NWS spent on travel in FY 1994, approximately $2.5 million was related to MARDI and $1.5 million was related to travel associated with new systems.

QUESTION

Are the transition costs of the modernization of the Weather Service travel costs or aren't they? Were the transition costs not among the expenses that the IG backed out of his report when he talked about the change of duty costs? (Lines 1118-1126)

ANSWER

Transition costs of the modernization associated with employees relocating to new duty stations is travel. It was proper for the IG to not back out these costs in the IG's report. The $37.125 million NOAA spent for travel does not include the approximately $20 million that NWS spent on transporting household goods, real estate expenses, and temporary quarters - costs associated with relocating employees to new duty stations.

QUESTION

The documentation received indicates that NOAA is owed over $100,000 and that almost $213,000 in travel expenses was paid to non-Department of Commerce employees. Some of the people who owe the government money for travel, in amounts as high as $4,000, have been dunned up to four times. In addition to the names of these people, which we've received, explain who these people are who have been getting advances of money and not paying it back. What is being done beyond continuing to send these people dunning notices to recover the money that has been advanced? (Lines 1127-1155)

ANSWER

NOAA travelers who have received advances for travel include NOAA employees and non-NOAA professionals, such as collaborators, technical advisors and consultants, who have been invited to travel. We have been discussing how to best satisfy your request. NOAA is providing your office reports on international travel by the Department of Commerce (DOC) employees and on international and domestic travel by non-DOC professionals traveling at NOAA's expense for fiscal years 1995 and 1996 (through March 17, 1996).

Since the OIG's report the following changes have occurred:

1. When an invitational traveler's reimbursement voucher is processed, the traveler is required to apply all the reimbursement against the outstanding advance. In the past, travelers were allowed to choose whether to apply the reimbursement voucher against the advance similar to Government employees. Since collection alternatives are not as available, and in an effort to eliminate outstanding balances, this option has been eliminated.

2. An effort is underway to identify and aggressively pursue invitational travelers with outstanding balances to either: 1) collect funds; or 2) obtain travel vouchers. Travel vouchers are needed for those invitational travelers who do not owe the government, but failed to file the proper forms after travel was completed.

QUESTION

There has been an indication that there has been a good deal of credit card abuse at NOAA. What is being done to make certain that has stopped? (Lines 1160-1164)

ANSWER

NOAA's record of credit card use is comparable to others within the DOC. DOC is continually taking steps to reduce credit card abuse. DOC's policy and procedures for monitoring the use of travel charge cards were written in consultation with the Office of Inspector General in 1993 to address employee misuse of credit cards and delinquent accounts. Although charges made upon travel charge cards issued for Government use are paid with the employee's personal funds, we believe the use of such a card is a privilege that should not be misused by any employee. It is essential for Department managers, supervisors, coordinators and card holders to be fully aware of the policy and procedures which, among other things, expressly prohibit using credit cards for personal purchases, and which require supervisors to discuss with the employee questionable charges and/or delinquencies of 60 days or more.

The Department has worked aggressively to continue to make employees aware of the policy and restrictions on the use of the card. Additional memoranda have recently been issued by the Chief of Staff and the Office of General Counsel. The Department is about to instruct all travel charge card coordinators to re-instruct managers charged with oversight of individual employee use of the card. This will be done through the Department's reissuance of its existing policy and procedures on the use of the contractor-issued travel charge card contained in the DOC Travel Handbook. These procedures outline the appropriate actions to be taken by agency officials for delinquencies or questionable charges made by employees. They include discussing the issue with the employee and giving the employee the opportunity to explain the expenditure or delinquency. If the explanation is inadequate or there is a second instance of abuse, the supervisor shall contact the servicing personnel office for a determination of the appropriate disciplinary action that shall be taken. At the discretion of the supervisor, the card may be revoked at that time.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Washington, D.C. 20230
OFFICE OF THE COMPTROLLER

JAN 31 1996

MEMORANDUM FOR: Frank DeGeorge
Inspector General

FROM: Andrew Moxam

SUBJECT: NOAA Travel Obligations are Misstated in Audit Report No. EAD-7129-5-0001/September 1995

My staff has investigated the variance present between NOAA's actual FY 1994 year-end travel obligations and the amount reported in subject audit report, Departmental Travel Expenses Need Better Control and Oversight. The audit report identifies NOAA's FY 1994 travel obligations as being $43.268 million. The actual FY 1994 travel obligation for NOAA, including reimbursable programs, as reported in NOAA's SF 225, Report of Obligations (by object class) was $37.125 million. This amount is composed of the following:

Operations, Research & Facilities (Direct)	$27.944M
Operations, Research & Facilities (Reimb)	8.251M
All other NOAA appropriations	.930M

The variance occurred because NOAA's automated financial management system (FIMA) was not used as the source for the amount reported to the Inspector General during the audit. The administrative report program, FSD Travel Disbursement by Sub-Object Class, was designed to provide disbursement information and included obligations in multiple object classes, not solely object class 21XX, Travel and Transportation of Persons.

The process required to reconcile the variances for each fiscal year between the official financial management records and the administrative reports your office used would require an extensive, labor-intensive audit of document files within the FIMA system. If your Office wishes to pursue a reconciliation effort, I propose that the independent auditing firm, KPMG, be tasked to provide reconciliation.

I don't think it's to NOAA's or your office's advantage to have this sort of situation repeated in the future. To this end, I'd appreciate your staff working with NOAA's Audits and Internal Control staff to arrange future reviews.

cc: D. Baker
D. Hall
D. Josephson

WASHINGTON EDITION

Southern California's Newspaper

Los Angeles Times

Monday January 22 1996

TIMES MIRROR COMPANY

AN EDITION OF THE LOS ANGELES TIMES

Audit Cites Travel Costs of Commerce Secretary

■ **Cabinet:** Brown's expenses are 145% above GOP predecessor's, and aides misuse credit cards, Times learns.

By SARA FRITZ
TIMES STAFF WRITER

WASHINGTON—Under Commerce Secretary Ronald H. Brown, travel expenses for the secretary's office have risen at least 145% over those of a well-traveled GOP predecessor, while many of Brown's aides are improperly using government credit cards for personal purchases, according to a confidential audit report obtained by The Times.

The report by the Commerce Department's inspector general also sharply criticizes Brown for supplementing his escalating travel budget with millions of dollars that Congress intended for other purposes.

In addition, it questions the Commerce Department's practice of paying in advance the expenses of nongovernment workers who travel as "consultants" for the administration. It notes that more than $360,000 in travel advances to these private citizens have never been repaid.

The report, which generally calls into question Brown's financial management of the Commerce Department, comes to light in the wake of the controversy over excessive travel spending by Energy Secretary Hazel O'Leary, whose penchant for numerous and expensive foreign trips was detailed by The Times.

Brown is already under

Please see BROWN, A8

Los Angeles Times Jan. 22, 1996 p. A8

BROWN: Commerce Chief's Travel Expenses Are Scrutinized by Audit

Continued from A1

investigation by a court-appointed independent counsel on a variety of charges unrelated to his travel expenditures—most of them involving his personal finances.

His spending levels are particularly striking since he took over the job from a Republican administration that was often under fire for incurring excessive travel costs. In particular, the extensive travels of former Commerce Secretary Robert A. Mosbacher, who served in the Bush administration, were often questioned by Democrats in Congress.

Like Mosbacher, Brown, a former chairman of the Democratic Party, was accused by his critics of using his travel budget to gain favor with political allies and party contributors, many of whom have been invited to accompany the secretary on his extensive foreign trips.

Carol Hamilton, Brown's press secretary, said the increased spending reflects the secretary's determination to be more of an activist than his predecessors in promoting the interests of American business.

"The Brown Department of Commerce is a far more activist Commerce Department, particularly in terms of export promotion," she said.

At the same time, she said, the department has taken steps to clamp down on the misuse of credit cards and to eliminate other problems cited by the auditors.

Judging from individual expense reports filed by Brown and his traveling companions, which also were obtained by The Times, the Commerce secretary's costs have risen in part because he makes numerous domestic and foreign trips. But records also show that he adds to the cost by taking along a sizable entourage of advisors and security personnel, along with an advance team whose tasks include arranging for hotel accommodations and ground transportation.

File Photo

Commerce Secretary Ronald Brown

Overall, according to the audit, travels by Commerce Department employees cost the taxpayers nearly $68 million in 1994, exceeding the budget set by Congress by about 55%. One Commerce Department agency alone, the National Oceanic and Atmospheric Administration—which helps pay for Brown's trips—exceeded its travel budget by $22 million in 1994.

Auditors found that the secretary and his office staff spent nearly $1.4 million from their own budget on travel during 1994, nearly 1-1/2 times more than the $552,389 spent in 1991 by Mosbacher and his aides.

In addition, auditors found, the secretary has supplemented his travel budget with hundreds of thousands of dollars drawn from other agencies within his department, including NOAA, the International Trade Administration and the Economic Development Administration.

For example, the report says the ITA and the EDA transferred funds from their budgets to pay for Brown's trips to Russia in March 1994 and to India in January 1995. Records indicate that NOAA routinely pays for Brown's bodyguards, both on foreign and domestic trips.

As a result of Brown's decision to use other agencies' funds for his trips, auditors were unable to determine precisely how much money the secretary has spent on travel. But the report quotes ITA officials as saying his travel expenditures from their budget reached $2 million in 1994 alone.

The inspector general's office says the practice of transferring funds between agencies was troublesome, but not illegal. "We found no violation of the letter of the appropriations law," the report says. "But we are concerned that the transfers weaken the integrity of the budgeting and appropriation process and expend funds in ways not anticipated by Congress."

Hamilton said Brown disagrees with the inspector general's criticism.

The report was first obtained from the Commerce Department by Citizens Against Government Waste, a conservative, Washington-based watchdog group, and the inspector general's office has declined further comment on it.

But on Capitol Hill, where decisions about Brown's travel budget are made, a spokesman for Rep. William F. Clinger Jr. (R-Pa.), chairman of the House Government Reform and Oversight Committee, expressed strong dissatisfaction with Commerce Department spending practices.

Brown's travel spending, he said, appears to be "in violation of Congress' power of the purse." Clinger, who also has a copy of the audit report, added that Americans would prefer to have their economic development funds spent on local community projects, not on foreign trips for Brown.

The auditors found widespread abuse of government credit cards within the Commerce Department, including "unpaid charges, use of charge card for personal purchases and automated teller machine advances not related to official travel." Among those issued these credit cards, according to Hamilton, are some nongovernment workers—some of them political associates of Brown—who are hired as consultants to accompany the secretary on his trips, often to make advance arrangements.

Specifically, they identified 293 employees with delinquent accounts and 567 who had used the card for ATM advances or personal charges, such as meals at fancy Washington restaurants, liquor, jewelry, flowers, books and music, online service fees and automobile insurance.

Hamilton described the problem as simply a "bookkeeping issue" and said department administrators have assured Brown that the money was not "inappropriately spent."

When confronted by the inspector general with these apparent abuses of government credit cards, according to the audit report, most agencies within the Commerce Department appear to have made a good-faith effort to ferret out the problem and respond in writing.

But Brown's own office appears to have been less cooperative. The report notes: "The coordinator in the office of the secretary gave us oral explanations for some of the questionable accounts, but told us that because of other pressing duties, she did not have sufficient time to provide written explanations."

At NOAA, the expense account coordinator complained that she could not possibly do a thorough job of monitoring credit card expenditures because she was the only person responsible for 5,000 to 6,000 cardholders.

Although the department subsequently made arrangements with American Express Co. to automatically block retail expenditures made with a government credit card, the inspector general noted that the system was far from foolproof.

The Commerce Department's efforts to collect repayments of travel advances from consultants also have been inadequate, according to the report. As of March 31, 1995, these nongovernment personnel had received 525 advance payments totaling $360,110 that had never been repaid.

Of the 83 nongovernment workers who traveled with the Commerce Department between 1992 and 1994, the report says, only two of them repaid their travel advances in full. While most of them made some accounting of their expenditures, however inadequate, nine of them filed no vouchers.

The report says 260 of the advances, totaling $119,552, were more than a year old and probably uncollectable. Recipients of 367 advances, totaling $195,861, had ignored four government notices seeking repayment.

Perhaps the harshest criticism leveled in the inspector general's report points to a lack of concern within the Commerce Department about these matters of financial management. "Oversight of travel spending by agencies appears virtually nonexistent beyond the commitment of funds," it concludes.

U.S. DEPARTMENT OF COMMERCE
Office of Inspector General

PUBLIC
RELEASE

OFFICE OF THE CHIEF FINANCIAL OFFICER AND ASSISTANT SECRETARY FOR ADMINISTRATION

Departmental Travel Expenses Need Better Control and Oversight

Audit Report No. EAD-7129-5-0001 / September 1995

Office of Audits, Economic Affairs Division

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EXECUTIVE SUMMARY

We audited aspects of Departmental travel expenses and identified significant problems:

- At a time of large increases in Departmental travel expenses (31 percent from fiscal year 1991 to 1994), we found several problems in controls over these expenses. For example, agencies arbitrarily transferred funds between Departmental appropriations to pay for travel. After obtaining accurate data, we determined that NOAA's travel expenses exceeded its budget by 84 percent in fiscal year 1994. Moreover, Departmental officials had provided no overall management control or monitoring of agencies' expenses. We expressed our concerns in a memorandum to the Chief Financial Officer and Assistant Secretary for Administration. (See page 5.)

- Numerous employees have misused the government travel charge card issued by American Express. Such abuses included excessive unpaid charges, use of the card for personal purchases, and questionable automatic teller machine advances. A primary reason for the abuse is a lack of management and oversight by agencies. (See page 8.)

- The Department has not taken adequate action to collect payment of outstanding travel advances from advisors and consultants who regularly travel on Departmental business. These non-employees owed more than 500 outstanding travel advances to the Department, totaling over $360,000, and many of the advances may be uncollectible. (See page 12.)

- Departmental management does not have reasonable assurance that the NOAA Finance Services Division's auditing of travel vouchers is cost-effective. The auditing process is flawed because FSD does not use a statistically sound basis to select the sample of vouchers. (See page 14.)

- NOAA cannot furnish reliable data on non-Commerce officials who travel for the benefit of the Department. (See page 18.)

On pages 7, 11, 13, 17, and 18, we recommend that the Chief Financial Officer and Assistant Secretary for Administration and, when appropriate, senior NOAA officials take action to monitor and control travel expenses, reflect travel expense needs in future budgets, provide accurate travel data, prevent American Express charge card misuse, collect outstanding travel advances from supplemental employees and audit travel vouchers on a sound and cost-effective basis.

The Office of Administration's response to our draft report issued on August 18, 1995, generally agreed with our findings that certain aspects of the travel program and expenses within areas of the Department require greater control and oversight. The response also pledged to specifically address the findings and develop an action plan that addresses the recommendations. We look forward to working with the Office of Administration to complete the action plan. The complete response issued by the Office of Administration is attached to the report as Appendix VIII.

INTRODUCTION

Travel by Department employees is subject to the Commerce Travel Regulations issued under the authority of Department Administrative Order 204-1 in accordance with the General Services Administration's Federal Travel Regulations. Authorizations to travel granted by individual Departmental agencies should also conform to the agency's authorizing legislation. Official travel by Foreign Service employees is authorized under the Foreign Service Act and the implementing Foreign Service Travel Regulations. All travelers, including non-Commerce employees (invitational travelers), whose travel expenses are paid by the Department must have written travel orders before beginning travel and incurring any expenses.

Responsibility of Agency Officials for Official Travel

The authority for authorizing travel vested in the Chief Financial Officer and the Assistant Secretary for Administration is delegated to the Secretarial officers, heads of Departmental agencies, and heads of operating units reporting directly to the Secretary. The Office of Executive Assistance Management in the Office of the Secretary develops, disseminates, and manages Department travel policies and procedures. Each agency head is expected to maintain effective control over all travel and travel expenditures. Each DOC agency is responsible for designating the officials who may authorize travel. The requesting and approving officials have the authority to request or approve travel subject to limitations established by each bureau head. Responsibilities of agency officials include:

1. Determining whether the travel is required, is in the interest of the government, and complies with the agency's overall travel plans.

2. Approving an itinerary that will most effectively serve program needs at the least cost.

3. Providing for the most economical mode of transportation that is consistent with services generally meeting acceptable standards and the mission objective.

4. Ensuring that the travel order is properly prepared and includes all necessary information.

5. Ensuring that the travel advance is properly authorized and the amount is appropriate.

6. Reviewing the travel voucher and submitting it for payment to the appropriate support center.

Experts or consultants may be allowed travel or transportation expenses while on official travel for the Department. Travel of persons other than federal employees may be approved only by officials designated by agency heads. Such travelers must be conferring on official business or performing a direct service to the government. Travel advances may be authorized by designated officials and issued to non-federal employees. In some instances, prospective employees may be authorized pre-employment interview travel and transportation expenses.

Review and Verification of Travel Expenses

The supervisory review of the completed travel voucher is primarily to confirm that the travel for which expenses are being claimed was performed as authorized. This review should not be a detailed audit for accuracy and should not duplicate the functions of voucher examiners and certifying officers in the payment centers/finance offices. The reviewer should be fully knowledgeable of the employee's activities. Review by the immediate supervisor is generally considered sufficient.

The National Oceanic and Atmospheric Administration processes the payment of travel expenses for all Departmental agencies within the United States except the Patent and Trademark Office and the National Institute of Standards and Technology, which have separate systems for processing travel. NOAA's Finance Services Division (FSD) in Germantown, Maryland, administers payments for travel by employees in the Washington, D.C., area. In addition, FSD:

- Provides procedural and policy guidance on the Federal Travel Regulations.
- Administers NOAA's domestic and foreign travel program, including the development of NOAA's travel management procedures.
- Coordinates travel payment issues with regional administrative support centers and counterpart organizations in Departmental agencies.

Voucher examiners in finance offices are responsible for ensuring that before vouchers are certified for payment, they are properly prepared according to pertinent regulations and agency procedures. The examiners conduct their reviews according to procedures prescribed by the General Accounting Office. They review claims to (1) ascertain the accuracy of the amounts claimed, (2) determine whether the types of expenses claimed are authorized and allowable, and (3) ensure that required receipts, statements, and justifications are attached to the voucher in support of the claimed expenses. Examiners also examine the supporting documents for unused passenger tickets and transportation refund applications and initiate the

refund process. Certifying officers assume ultimate responsibility for these actions when certifying a voucher for payment.

Use of American Express Travel Charge Card

On September 30, 1993, the General Services Administration contracted with American Express to provide a system of individually billed employee travel accounts with automated teller machine access, travelers checks, and a charge card for employees to use during official travel. American Express establishes the accounts at the agency's request without prior credit-worthiness checks. Accounts initially have no preset single purchase or monthly spending limits for travel and subsistence.

The government will reimburse employees only for authorized and allowable expenses, i.e., hotel and subsistence expenses within the per diem rate. Any amounts charged in excess of the allowable reimbursement must be paid to American Express out of the employee's personal funds. The government assumes no liability for any charges made using the card.

The DOC Travel Handbook explicitly limits the use of the charge card to expenses incurred for officially authorized government travel. Personal use of the card is prohibited. Employees must sign a statement acknowledging that they have read and understand the policies and procedures related to the use of the card. Employees also must pay their charge card bills, in full, on or before the next statement billing date. The responsibilities and conduct mandated by 15 CFR 0.735-16 require DOC employees to make proper and timely payments for each just financial obligation.

Under the handbook, managers are responsible for notifying an employee's immediate supervisor of any questionable expenditures and/or delinquencies of 60 days or more in the payment of accounts. A supervisor is responsible for (1) giving the employee an opportunity to explain the expenditure or delinquency, (2) maintaining a record of the discussion with the employee, (3) taking appropriate disciplinary action if the explanation is inadequate, and (4) revoking the card if there is a second instance of inappropriate use or insufficient explanation for the delinquency. Departmental penalties for abuse of the card range from a written reprimand to removal.

Purpose and Scope of Audit

The purpose of our audit was to review and evaluate internal controls applicable to the systems used to authorize and approve travel within the Department of Commerce. We reviewed applicable regulations, policies, and procedures; examined appropriate files and records; and interviewed cognizant personnel. We focused our review of the voucher

examining process on the Commerce organizations serviced by FSD. The audit was performed from November 1994 to July 1995.

Our audit was structured to determine compliance with the provisions of the Federal Travel Regulations and the DOC Travel Handbook, including those provisions that prescribe internal controls over the use of travel funds. In addressing our audit objectives, we evaluated internal controls applicable to the operational areas reviewed. We found noncompliance with the Handbook and significant weaknesses in internal controls, as described on the following pages.

Some of the information presented in our report relies significantly on cost data generated by the Department's and NOAA's computerized systems. We did not fully assess the reliability of computer-generated data because a new automated travel system is being implemented. We therefore conducted additional audit work to verify selected data generated by the system, and we can provide conclusions and recommendations with respect to the verified data. We must qualify our report accordingly. With that exception, our work was conducted in accordance with generally accepted government auditing standards. The audit was performed under the authority of the Inspector General Act of 1978, as amended, and Department Organization Order 10-13, dated May 22, 1980, as amended.

FINDINGS AND RECOMMENDATIONS

DEPARTMENTAL AND AGENCY OFFICIALS SHOULD MONITOR AND CONTROL TRAVEL EXPENSES

Our audit disclosed a large increase in travel expenses and a lack of control and monitoring of such expenses. Agencies arbitrarily transfer funds between Departmental appropriations to pay for travel. Further, NOAA has not furnished accurate data on travel expenses to the Department, with a total loss of reliable travel data for FY 1992. Officials in the Office of the Secretary provide no overall management control or monitoring of travel expenses by the agencies. We expressed our concerns about travel expenses in a memorandum to the Chief Financial Officer and Assistant Secretary for Administration (see Appendix I).

Travel Expenses Increased Significantly and May Have Exceeded Budget Estimates

From fiscal year 1991 to 1994, Departmental travel expenses increased 31 percent, from $52 million to $68 million. The biggest dollar increase was in NOAA, where travel expenses rose $13.9 million (about 47 percent). The largest percentage increase was in the National Technical Information Service, where travel expenses rose about 235 percent. Travel by the Office of the Secretary increased by 145 percent during this period. The increases in travel expenses by each agency are shown in Appendix II.

We informed the Chief Financial Officer and Assistant Secretary for Administration that preliminary figures indicated that agencies exceeded their FY 1994 travel budget estimates by 55 percent. We subsequently found that the information given us did not provide a proper basis for comparing actual expenses to budgeted amounts. After determining the actual expenses, we found that NOAA travel expenses for FYs 1991, 1993, and 1994 exceeded budget estimates by approximately 49, 73, and 84 percent, respectively. Because of the time that would be required, we did not attempt to determine whether other agencies' or total Departmental travel expenses also exceeded budget estimates for those periods.

Agencies Transferred Funds Between Appropriations Accounts for Travel

Commerce agencies transfer funds to other Departmental agencies to pay travel expenses. International Trade Administration funds have been used for travel by the Office of the Secretary, and the Economic Development Administration transferred public works funds to the Technology Administration and the International Trade Administration. We found no violation of the letter of the appropriations law, but we are concerned that the transfers weaken the integrity of the budgeting and appropriation process and expend funds in ways not anticipated by the Congress.

Virtually all of the foreign travel expenses of the Office of the Secretary are administered and paid by ITA. ITA is reimbursed only $100,000 per year for Secretarial travel, although ITA officials told us that travel expenses of the Office of the Secretary totaled about $2 million in fiscal year 1994 and were between $500,000 and $1 million at the mid-point of fiscal year 1995. Although the travel is ITA-related (trade missions, etc.), the budgeted appropriations should include all funds reasonably expected to be expended, including travel expenses. Moreover, in our opinion, annual budget requests should disclose the funds transferred within the Department for travel expenses during the previous fiscal year.

EDA also transferred funds for travel expenses through reimbursable interagency agreements. EDA and ITA signed a memorandum of understanding in April and May 1994 to support a business development mission to Russia. EDA then obligated and transferred $40,000 to ITA to support the mission headed by the Secretary of Commerce from March 27 to April 2, 1994. The funds were for such expenses as transportation, lodging, meals, materials, and preparation of a report to the President.

In June and July 1994, EDA agreed to transfer $50,000 to ITA in support of the U.S.-Israel defense conversion initiative. Since the Technology Administration, and not ITA, ultimately implemented this initiative, EDA transferred the funds to TA in September 1994 under an amended memorandum of understanding. Through TA, the U.S.-Israel Science and Technology Commission recruited a trade mission involving U.S. government officials and U.S. companies in the area of civilian commercialization of defense technologies. The mission featured seminars, meetings on marketing strategies and matchmaking for joint ventures, and briefings with top-level Israeli and U.S. officials.

Also, EDA and ITA drafted a memorandum of understanding to support a business development mission in which the Secretary led a delegation of American business executives to India in January 1995. The memorandum of understanding provided that EDA would obligate and transfer $20,000 to ITA to pay travel expenses, including transportation, lodging, meals, materials, and preparation of a report to the President.

EDA budget officials told us that the transfers are permitted under Section 301(c) of the Public Works and Economic Development Act, but we question their interpretation. The act states that the Secretary of Commerce shall conduct a continuing program to determine the causes of unemployment and formulate and implement solutions. Subsection (c) authorizes the Secretary to conduct the program in various ways, including "through payments of funds authorized for this section to other departments or agencies of the Federal Government..."

While the act may technically allow for use of public works funds for travel by ITA and Secretarial officials, the funds are more clearly identified with the implementation of economic development programs in high-unemployment areas of the United States. We

strongly doubt that the Congress intended that appropriated public works funds would be used to pay foreign travel expenses of other agencies. We believe that Commerce agencies should request travel funds directly through the budget process.

FSD Should Report Accurate Travel Data to the Department

As a result of serious deficiencies in systems for recording travel expenses, we requested that FSD officials reconstruct actual Departmental travel expenses. The deficiencies involve discrepancies in NOAA's reporting of actual travel expenses to the Department. FSD reports data on travel expenses in two different formats--object class and purpose. We noted significant differences in the data reported in each format for fiscal years 1993 and 1994, and we were unable to determine the reason for the differences. Moreover, the travel expenses reported for fiscal year 1992 were almost double those reported for other years, suggesting that the data was unreliable. FSD officials told us that a flaw in the fiscal year-end processing procedures resulted in a combination of data from fiscal years 1991 and 1992. These problems were not analyzed or corrected until we brought them to FSD's attention.

RECOMMENDATIONS

We recommend that the Chief Financial Officer and Assistant Secretary for Administration take the following actions:

1. Monitor total Departmental travel expenses and direct agency officials to ensure that actual travel expenses do not exceed budgeted expenses.

2. Ensure the integrity of the budget process by directing that (1) agency budget requests include all anticipated travel expenses and (2) transfers of appropriated funds between agencies to pay for travel expenses are limited to a *de minimus* amount and only on an emergency basis.

3. In conjunction with senior NOAA officials, ensure that Departmental travel expense reports by object class and purpose of travel are properly reconciled and that year-end processing procedures provide for proper fiscal year cutoff of data.

AGENCIES SHOULD TIGHTEN OVERSIGHT OF AMERICAN EXPRESS CHARGE CARD ACTIVITIES

Upon reviewing charge card use at selected agencies, we found evidence of abuse of the charge card privilege by numerous employees. Such abuse included unpaid charges, use of the card for personal purchases, and automatic teller machine (ATM) advances not related to official travel. A primary reason for the abuse is a lack of management and oversight by Commerce agencies.

Employees Misused American Express Charge Cards

We examined monthly reports prepared by American Express of employees' charge card activity at four agencies (Census Bureau, International Trade Administration, National Oceanic and Atmospheric Administration, and Office of the Secretary). We identified 293 employees with delinquent accounts (60 days or more past due). We found 567 who appeared to have used the card for personal charges or questionable ATM advances. The questionable uses include payments for meals at Washington-area restaurants by headquarters employees; purchases of liquor, jewelry, flowers, books, and music; and payment of computer on-line service fees and automobile insurance.

Senior Agency Officials Must Monitor Card Usage and Halt Abuses

Managers in Department bureaus and operating units are responsible for designating certain employees to act as coordinators to administer the government charge card program. Charge card coordinators are responsible for (1) monitoring the monthly charges and delinquency notices and (2) notifying the appropriate bureau managers of possible misuse or delinquencies of 60 days or more.

We submitted some examples of American Express reports showing delinquencies or charges in question to the agency coordinators. We asked them to examine the circumstances surrounding the delinquency or use of the card; provide additional information, such as explanations from supervisors or employees; and provide evidence of actions taken.

- The Census Bureau coordinator advised us that 22 charges were for official use and 10 were for personal use. The coordinator also said that some employees surrendered their cards and the bureau canceled other cards. In addition, the bureau issued a memorandum reminding all cardholders to use the card only for official government travel. However, the coordinator did not furnish us with detailed explanations for each questionable charge.

- In ITA, the coordinator prepares a memorandum from the Director of Administration to the appropriate Deputy Assistant Secretary with attached lists of (1) cardholders who have accounts that are at least 60 days delinquent and (2) staff who may have used the card to purchase personal items. The Deputy Assistant Secretary is asked to have the employee's supervisor talk to the employee. The Director of Administration requests comments within five days of the receipt of the memorandum.

  ITA's coordinator made a good effort to explain the delinquent balances or questionable charges we gave her. As a result, she provided us with written or oral explanations for many items in our sample. The coordinator's actions led to cancellation of some charge cards. However, despite her efforts, numerous questionable items were not explained.

- The NOAA coordinator had difficulty responding to our request because she is the only one who actually reviews charge card use by the 5,000 to 6,000 cardholders in NOAA. Consequently, she cannot adequately monitor the many monthly charges and delinquencies and notify the appropriate bureau managers of potential misuse. In a separate memorandum (see Appendix V), we recommended that NOAA assign this control function to as many personnel as needed to perform timely reviews of the monthly activity reports, and to identify and report possible misuse and delinquencies.

- The coordinator in the Office of the Secretary gave us oral explanations for some of the questionable accounts but told us that because of other pressing duties, she did not have sufficient time to provide written explanations.

Because we were unable to obtain complete explanations from the agency coordinators, we sent memoranda to agency heads with lists of employees with delinquent accounts (60 days or more past due) and with probable personal charges and questionable ATM advances. We also included sections of the American Express reports showing the delinquencies or charges in question.

We asked the officials to examine the circumstances surrounding the delinquency or personal use of the charge card by these employees and provide a written explanation. We also asked the agencies to inform us of the administrative action proposed for employees who misused the card privileges. Further, we asked the officials to ensure that agency managers, supervisors, coordinators, and cardholders are thoroughly familiar with the Department's procedures for managing and using the government charge cards. (Copies of the memoranda sent to agency heads are attached as Appendices III through VI.) To date, we have received three responses to our memoranda, which we are currently evaluating.

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Senior Departmental officials have explicitly reminded all employees of their duties and responsibilities under the charge card program. The Chief of Staff and the Assistant General Counsel for Administration issued memoranda on December 15, 1994, reminding employees of prohibitions against misuse of the charge card. (See Appendix VII.) Nevertheless, at the agencies reviewed, we do not have reasonable assurance that the cardholders and supervisory officials are implementing the Department's procedures for reviewing monthly reports and halting card misuse.

Department Should Ensure That American Express Blocks Improper Retail Use

As stated above, we found numerous instances in which employees used the American Express card in retail establishments not normally associated with official travel expenses. Agency coordinators advised us that they thought that American Express had instituted a "retail block" to prevent retail use of the cards. A representative from the American Express Company told us the retail block was implemented in April 1994 in response to a written request from the Department. The block, however, has certain problems and limitations:

- Retailers have floor limits for approval. If the sale is below the floor limit, the store does not have to call American Express for approval.

- The retail block was automatically placed on all existing DOC cards in April 1994. Since then, the block has had to be installed manually for new members, but some cards have been missed. Recently, arrangements were made to have the retail block again put on all cards.

- Merchant numbers have different classifications. "Retail purchases" is a catchall category that might include numerous types of payments, including catalog orders and seminars. When cardholders complained that when they could not use their cards to pay parking fees in a garage while on travel, American Express removed the block from their cards but did not later reinstall it.

The Department should work with American Express place an effective retail block on the employee use of the government card. The American Express representative for the Department told us that most retailers now run the cards through an electronic device that gives instant approval or rejection for all charges, and the company is moving toward 100-percent approval of all charges. Consideration could be given to requiring 100-percent approval for all government card use. The Department and American Express could also specifically allow employees to use the card at certain types of retail operations, such as parking garages.

RECOMMENDATIONS

We recommend that the Chief Financial Officer and Assistant Secretary for Administration take the following actions:

1. Ensure that department managers, supervisors, coordinators, and cardholders are thoroughly familiar with the Department's procedures for managing and using the American Express travel charge card.

2. Direct that senior agency officials regularly review charge card use and take appropriate administrative action against employees who misuse the card.

3. Negotiate with the American Express Company to place a more effective block on improper retail purchases with the card.

DEPARTMENT MUST IMPROVE CONTROLS OVER TRAVEL ADVANCES TO SUPPLEMENTAL EMPLOYEES

Technical advisors and consultants who regularly travel on Departmental business are qualified to receive Departmental travel funds under chapter 301-1.104 of the DOC Travel Handbook. The Department frequently provides travel advances to these travelers, referred to as "supplemental employees," for official travel purposes. While supervisors can deduct outstanding travel advances from the salary check or retirement account of an employee, collecting outstanding travel advances from supplemental employees is more difficult.

The Department has not taken adequate action to collect payment of outstanding travel advances from advisors and consultants who regularly travel on Departmental business. Our audit disclosed that these non-employees owed more than 500 outstanding travel advances to the Department, totaling over $360,000, and that many advances have been outstanding for long periods and may be uncollectible. Unpaid advances represent loss of funds by the Department and should not be tolerated. FSD and the agency officials who supervise such travelers need to take all possible action to ensure repayment of these travel advances.

Agency officials currently have no effective means of ensuring that supplemental employees repay travel advances. FSD maintains a record of the employee's social security number, home address, and agency contact point, and furnishes a report of outstanding advances to bureau officials. Bureau officials are responsible for contacting the persons cited on the report as having outstanding balances and obtaining prompt repayment. If bureau officials are unable to obtain the required payment, a memorandum should be sent to FSD or the appropriate finance office, requesting that a formal bill or notice be sent to the supplemental employee.

As of March 31, 1995, supplemental employees had 525 outstanding advances totaling $360,110. Our analysis showed the following:

- FSD issued notices to request payment for 367 (about 70 percent) of the outstanding advances, valued at $195,861. Of that group, 276 had received *four* notices requesting payment of the outstanding advances, valued at $132,698.

- 260 of the outstanding advances, valued at $119,522, were over one year old. As outstanding advances age, they are less likely to be collectible.

Travelers eliminate travel advance balances by submitting travel vouchers to apply against the outstanding balance or by paying any excess balance to the Department. We were able to locate the travel histories of 83 supplemental employees who traveled in fiscal years 1992-94, and we found that only *two* repaid the full amount of all advances. Another 72 filed

vouchers, but did not repay the full amount of the advance. The remaining nine did not even file a voucher, thus failing to account for their use of any of the government's travel funds.

FSD needs to implement improved controls for travel advances provided to supplemental employees to ensure that (1) employees file travel vouchers and (2) vouchers filed are applied against outstanding advances. One such control would be to provide supplemental employees with only partial advances in order to encourage them to file vouchers to obtain full reimbursement for travel expenses. FSD also needs to identify uncollected advances made to supplementary employees, then consider alternative means of collecting them.

RECOMMENDATIONS

We recommend that the Chief Financial Officer and Assistant Secretary for Administration take the following actions:

1. Provide supplemental employees with only partial advances in order to encourage them to file vouchers.

2. Require that vouchers filed by supplemental employees be applied toward any outstanding advance balances.

3. Identify uncollected advances and use alternative methods, i.e., debt collection agencies, to improve repayment of travel advances.

FSD SHOULD REVISE AND DOCUMENT TRAVEL VOUCHER SAMPLING PLAN

Departmental management does not have reasonable assurance that FSD's auditing of travel vouchers is cost-effective. The auditing process is flawed because FSD does not use a statistically sound basis to select the sample of vouchers. Also, the examiners do not analyze the sampling results to determine if the sample size is appropriate. As a result, the examiners cannot assess trends or diagnose problems in overall travel spending. Although the sampling plan for the audit of travel vouchers has been in effect for several years, division staff could not provide us with the basis for the plan.

Statistical sampling in voucher examination relies on the principles of probability to collect quantitative facts about the accuracy and other characteristics of a universe of vouchers by reviewing a statistically selected sample of that universe. Examining the items in the sample and evaluating the results permit not only the correction of errors and other deficiencies found in the items sampled and in relevant procedures and controls, but also mathematical projections as to the quality of all vouchers in the universe. The results of such sampling can be the basis for correcting deficiencies in procedures or controls to correct deficiencies in the voucher processing system. Analysis of the sample results also provides the data needed to confirm the continuing validity of the sampling plan or, when appropriate, to modify it.

Agency heads are authorized by 31 U.S.C. 3521(b) to establish statistical sampling programs, within limitations prescribed by the Comptroller General, for examining vouchers in support of their certification and payment. The General Accounting Office's Policy and Procedures Manual, Chapter 7, Appendix III, dated May 1993, provides guidance for the use of statistical sampling in auditing vouchers. The Comptroller General has established a general limitation of $2,500 on vouchers that may be examined by sampling programs. Agencies may establish their own dollar limitations within this maximum based on cost-benefit analyses of their voucher examining operations.

Because statistical sampling is a means of reducing the cost of unproductive voucher examinations, it must be supported by appropriate cost evaluations. When sampling is undertaken, its propriety should be reevaluated periodically. The use of sampling does not preclude agencies from also using computerized edits and other techniques designed to ensure the accuracy and reasonableness of data and to improve the efficiency and effectiveness of voucher examining.

A determination to employ statistical sampling should be supported by a comparison of the costs and benefits of carrying out alternative voucher examination procedures. As appropriate, the agency should categorize vouchers by type and dollar range to make these

comparisons effective in identifying the dollar thresholds below which savings would result from statistical sampling. The measure of such savings would be the difference between (1) the cost of examining all vouchers and (2) the combined costs of (a) examining the sample and (b) projected losses due to undetected errors in the vouchers not examined.

Using statistical sampling for voucher examination involves identifying objectives and scientifically acceptable approaches for the design, implementation, and subsequent revision of a formal sampling plan. To develop and implement the plan and to monitor its operation, agencies generally have to do the following.

1. Define the universe of vouchers to be examined by statistical sampling, including the period for the sample (e.g., a week, a month).

2. Determine the size of the sample needed and how the sample items will be selected.

3. Analyze the results of the sample using appropriate statistical procedures and determine if any changes are needed to the sampling plan or whether to examine the entire universe.

4. Present the results to management with appropriate interpretation.

The agency must maintain records of all aspects of its sampling plan, including the specific sampling procedures, the statistical formulas or tables used, and the resulting calculations. Further, records of actual application of the plan--such as (1) work sheets showing items selected for examination, (2) errors discovered, (3) total number and amount of vouchers in the universe, (4) projected error, including possible range of error in the universe, and (5) acceptability of the results--should be retained to document the implementation of the plan and any changes made based on the sample results. These records, which reflect actual operation of the plan, should be subject to the same retention-disposal criteria as other documentation in support of agency disbursements. All records pertaining to the voucher examination system should be available for review by management and audit personnel.

FSD uses the following criteria to select travel vouchers for audit:

- 10-percent statistical sampling of travel vouchers for domestic and foreign travel for amounts up to $
- 100-percent audit of all domestic and foreign vouchers for amounts exceeding $
- 100-percent audit of all vouchers.

FSD also selects additional vouchers for audit to verify reasonableness, using the following criteria:

- o Per diem over $
- o
- o Rental cars over $
- o
- o
- o

FSD could not provide us with the basis in sampling theory for the plan. For example, there was no explanation for the cutoff point for sampling vouchers, nor was there a rationale for the selection of the reasonableness criteria.

In 1991, NOAA's Office of the Comptroller conducted a study to determine if the percentage of travel vouchers audited could be reduced. At the time of the study, the random selection rate for audit of temporary duty (TDY) travel vouchers was also percent. The study determined that it cost $2.33 to audit a TDY domestic travel voucher, and $9.35 to audit a TDY foreign travel voucher. The study reported that the audit findings in both cases exceeded the costs and concluded that it could not make a cost-benefit case for raising the threshold. The cost-benefit analysis, however, was not conducted in accordance with the GAO guidance.

The 1991 study was the last analysis conducted, and FSD continues to use the same sampling plan that was in effect then. A senior voucher examiner advised us that the plan has been in effect since at least 1986, and that FSD does not retain or analyze the results of the sample of vouchers audited. Further, a 1990 report by NOAA's Office of the Comptroller revealed that no division employee was familiar with the contents of the audit computer program and that there was no documentation.

In response to our audit inquiries, FSD prepared a report of audit adjustments to vouchers during June 1995. The report indicates the total number of vouchers processed during the month, the number of vouchers audited, and the average adjustment to the vouchers as a result of the audit. The report also indicates that the average cost of auditing a domestic voucher has risen to $3.29. Applying the GAO guidance and the new data to determine whether the current process results in savings, we determined that it is not cost-effective.

The projected losses due to undetected errors in unexamined vouchers exceed the cost of auditing the vouchers. FSD needs to reevaluate its sampling plan for the audit of travel vouchers.

RECOMMENDATIONS

We recommend that the Chief Financial Officer and Assistant Secretary for Administration, in conjunction with senior NOAA officials, revise the statistical sampling plan for the audit of travel vouchers, based on application of the criteria in the GAO's Policy and Procedures Manual, Chapter 7, Appendix III, and sound sampling theory. Thereafter, FSD should maintain sufficient records to document the implementation of the plan and any subsequent changes needed based on the sample results.

FSD NEEDS TO FURNISH RELIABLE DATA ON INVITATIONAL TRAVELERS

NOAA has not been able to furnish us with reliable data on travel by invitational travelers for the Department. Such travelers must be conferring on official business or performing a direct service to the government. FSD staff have not properly maintained the records for these travelers. As a result, travel information, such as the total invitational travel funds spent in a fiscal year, cannot be reliably determined.

FSD provided us with a supplemental file of 17,000 individuals who were represented to be invitational travelers during the period from January 1989 through February 1995. A small sample of travel orders and vouchers for individuals on the list showed that most of them were actually DOC recruits who were issued travel orders before they officially became employees. Since the travel computer system will process records only for official employees, such recruits' records were placed in the supplemental file to ensure that their travel vouchers could be processed. For example, two individuals hired as ITA commercial officers were issued travel orders to report to Washington to be sworn in and trained, and then sent to a foreign post. They were not official employees when the travel orders were issued, so they were placed in the supplemental file.

Consequently, the supplemental file contained current employees as well as invitational travelers. FSD has a process for removing names from the supplemental file, but division officials have not used it to maintain a clean file. FSD should maintain reliable and accurate records for invitational travelers to ensure that their travel can be properly monitored.

RECOMMENDATION

We recommend that the Chief Financial Officer and Assistant Secretary for Administration, in conjunction with senior NOAA officials, ensure that reliable and accurate records are maintained for invitational travelers by removing employee records from the supplemental file of invitational travelers.

The Inspector General
Washington, D.C. 20230

APR 5 1995

MEMORANDUM FOR: Thomas R. Bloom
Chief Financial Officer and
Assistant Secretary for Administration

FROM: Frank DeGeorge

SUBJECT: Departmental Travel Spending

In today's budget environment, it is more important than ever that government agencies effectively manage their programs by being fiscally responsible, properly accounting for expenditures, and ensuring that expenditures make a demonstrable contribution to program effectiveness. With this in mind, we currently are conducting an audit of departmental travel expenses. Although our audit is still ongoing, we have identified several concerns to bring to your attention. We will issue an audit report at a later date.

- Departmental records indicate that total travel spending increased 31 percent from FY 1991 through FY 1994 to $67 million. Our preliminary figures also indicate that agencies exceeded their FY 1994 travel budget estimates by 55 percent. For instance, NOAA apparently exceeded its fiscal year 1994 travel budget estimate by about $22 million. NOAA officials have not provided us with a complete explanation for the overspending.

- Agencies have transferred significant amounts of funds within the department to pay for travel. The transfers might hinder planned program operations and clearly are not reflected in travel budget estimates submitted to Congress with the budget.

- Travel costs apparently are not reported accurately or completely on a departmental level. As a result, the department does not have accurate information to manage their travel costs. Three separate accounting systems are now in use across the department to account for travel expenses. We found that reports submitted to the department are often erroneous and that data processing errors have occurred.

- The NOAA Office of Administration is responsible for examining all travel vouchers over , , and 10 percent of those vouchers under . But the examination process is flawed because the office does not use a statistically sound basis to select the sample of vouchers. The examiners do not maintain records of the examinations and their results and do not analyze the results to determine if the sample size is appropriate. As a result, the examiners cannot assess trends or diagnose problems in overall travel spending.

- Oversight of travel spending by agencies appears virtually nonexistent beyond the commitment of funds. Travel regulations do not require senior officials to document their analysis of the contribution of travel to the mission of their agencies or the department. Neither do the regulations require any post-travel review to ensure that the travel met objectives in the most cost-effective manner. Travel regulations also allow travel with departmental funds by non-Commerce employees by invitation, if the authorizing official finds some nexus to the agency's mission. Absent a requirement to substantively document the value of the travel to the agency, we doubt that agency officials have an incentive to focus their travel on those trips which are absolutely necessary.

We are bringing these concerns to your attention at this time rather than waiting for the audit report so you may begin corrective action. Travel is a type of discretionary spending that needs to be controlled in today's austere environment. We are not suggesting micro-management of travel in the department. However, we are suggesting macro-level financial management to limit travel expenditures to only that level needed to meet program goals. If you have any questions or would like additional information, please do not hesitate to contact me.

cc: David Barram
Deputy Secretary of Commerce

APPENDIX II
COMPARISON OF DOC TRAVEL EXPENSES
FISCAL YEARS 1991 AND 1994

Agency	Expenses FY 1994	Expenses FY 1991	Difference	Percentage Increase
OS	$ 1,354,887	$ 552,389	$ 802,498	145.28%
MBDA	411,695	364,672	47,023	12.89%
Census	3,127,849	7,261,784	(4,133,935)	(56.93)%
NTIA	523,955	749,477	(225,522)	(30.09)%
NIST	9,368,634	5,798,123	3,570,511	61.58%
USTTA	269,729	171,092	98,637	57.65%
NTIS	124,667	37,217	87,450	234.97%
ITA	5,984,591	4,303,542	1,681,049	39.06%
NOAA	43,268,185	29,441,633	13,826,552	46.96%
BEA	130,437	136,726	(6,289)	(4.60)%
EDA	1,130,506	799,130	331,376	41.47%
OIG	517,413	548,053	(30,640)	(5.59)%
BXA	733,329	1,077,131	(343,802)	(31.92)%
PTO	796,360	368,952	427,408	115.84%
TOTALS	**$ 67,742,237**	**$ 51,609,921**	**$ 16,132,316**	**31.26%**

The Inspector General
Washington, D.C. 20230

JUN - 6 1995

MEMORANDUM FOR: Martha Farnsworth Riche
Director
Bureau of the Census

FROM: Frank DeGeorge V
Inspector General

SUBJECT: Use of American Express Cards

As a part of our audit of Department travel expenses, we reviewed the management and use of government charge cards issued by the American Express Company. We found (1) a need for better management and oversight of card activities, and (2) evidence of abuse of the charge card privilege by several Census employees. As discussed below, we are recommending that you take action against individuals who have misused the American Express travel charge card for personal use.

The DOC Travel Handbook limits the use of the contractor-issued government charge card to expenses incurred for officially authorized government travel. Personal use of the card is not authorized. Automatic Teller Machine cash advances and purchases made in retail stores are limited to official travel business.

Employees must sign a statement acknowledging that they have read and understand the policies and procedures related to the use of the contractor-issued travel charge card. This statement reinforces the requirement that use of the card is limited to official government travel and that personal use of the card is prohibited.

Employees also must pay their charge card bills, in full, on or before the next statement billing date. Employees are personally liable for all charges incurred. The employee responsibilities and conduct provided in 15 CFR 0.735-16 require DOC employees to make proper and timely payments for each just financial obligation. An employee's supervisor may take corrective actions (cancellation of the card and/or other administrative action) if the employee fails to pay the bill. The Department penalty guidelines for violation of this conduct standard range from a written reprimand to removal.

Managers in Department bureaus and operating units are responsible for designating employees to act as coordinators to administer the government charge card program. Managers also are responsible for notifying the employee's immediate supervisor of any questionable expenditures and/or delinquencies of 60 days or more in the payment of accounts.

The supervisor is responsible for (1) giving the employee an opportunity to explain the expenditure or delinquency, (2) maintaining a record of the discussion with the employee, (3) taking appropriate disciplinary action if the explanation is

inadequate, and (4) revoking the card if there is a second instance of inappropriate use or insufficient explanation for the delinquency. Charge card coordinators are responsible for (1) monitoring the monthly charges and delinquency notices, and (2) notifying the appropriate bureau managers of possible misuse or delinquencies of 60 days or more.

We reviewed American Express Company reports, showing charge card usage by Census employees for the period January 16 through March 17, 1995. We found that several employees had delinquent account balances, probable personal charges, or questionable Automatic Teller Machine advances. Since the card is to be used for only official travel purposes, we considered any charges within the vicinity of an employee's duty station to be possible personal usage. Also, we noticed charges made at vendors not normally associated with official travel, such as department stores.

We gave the Census coordinator a list of questionable charges and asked for additional information such as explanations from employees and supervisors and evidence of actions taken. The coordinator subsequently advised us that 22 charges were for official use and 10 were for personal use. Also, the coordinator advised that some cards were turned in and others were canceled. In addition, Census issued a memorandum reminding all cardholders to use the card only for official government travel.

The coordinator should be commended for the actions taken in response to our review. However, the coordinator did not furnish us with detailed explanations for each questionable charge. We need more assurance that the Department's procedures for reviewing monthly reports and following up on misuses of charge cards are fully implemented and followed.

Attachment 1 lists employees with delinquent accounts (60 days or more past due), and Attachment 2 lists employees with probable personal charges and questionable ATM advances. We also have included sections of the American Express reports showing the delinquencies or charges in question. Please examine the specific circumstances surrounding the delinquency or personal use of the American Express card by these employees and provide us with a written explanation within 30 days. Please include a statement as to the administrative action proposed for employees who have misused the card privileges.

Also, please take action to ensure that Census managers, supervisors, coordinators, and cardholders are thoroughly familiar with the Department's procedures for managing and using the government charge cards.

If you have any questions, please contact Andrew Cochran, Director, Economic Affairs Audit Division, on 482-0067.

Attachments

cc (without attachments):

Everett M. Ehrlich, Under Secretary for Economic Affairs
Frederick Alt, Principal Associate Director and Chief Financial Officer

bcc(without attachments):
IG CHRON
IG SUBJECT
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APPENDIX IV

UNITED STATES DEPARTMENT OF COMMERCE
The Inspector General
Washington, D.C. 20230

JUN - 6 1995

MEMORANDUM FOR: Jeffrey E. Garten
Under Secretary for
International Trade

FROM: Frank DeGeorge
Inspector General

SUBJECT: Use of American Express Charge Cards

As a part of our audit of Department travel expenses, we reviewed the management and use of government charge cards issued by the American Express Company. We found (1) a need for better management and oversight of card activities and (2) evidence of abuse of the charge card privilege by several ITA employees. As discussed below, we are recommending that you take action against individuals who have misused the American Express travel charge card for personal use.

The DOC Travel Handbook limits the use of the contractor-issued government charge card to expenses incurred for officially authorized government travel. Personal use of the card is not authorized. Automatic Teller Machine cash advances and purchases made in retail stores are limited to official travel business.

Employees must sign a statement acknowledging that they have read and understand the policies and procedures related to the use of the contractor-issued travel charge card. This statement reinforces the requirement that use of the card is limited to official government travel and that personal use of the card is prohibited.

Employees also must pay their charge card bills, in full, on or before the next statement billing date. Employees are personally liable for all charges incurred. The employee responsibilities and conduct provided in 15 CFR 0.735-16 require DOC employees to make proper and timely payments for each just financial obligation. An employee's supervisor may take corrective actions (cancellation of the card and/or other administrative action) if the employee fails to pay the bill. The Department penalty guidelines for violation of this conduct standard range from a written reprimand to removal.

Managers in Department bureaus and operating units are responsible for designating employees to act as coordinators to administer the government charge card program. Managers also are responsible for notifying the employee's immediate supervisor of any questionable expenditures and/or delinquencies of 60 days or more in the payment of accounts.

The supervisor is responsible for (1) giving the employee an opportunity to explain the expenditure or delinquency, (2) maintaining a record of the discussion with the employee,

(3) taking appropriate disciplinary action if the explanation is inadequate, and (4) revoking the card if there is a second instance of inappropriate use or insufficient explanation for the delinquency. Charge card coordinators are responsible for (1) monitoring the monthly charges and delinquency notices, and (2) notifying the appropriate bureau managers of possible misuse or delinquencies of 60 days or more.

We reviewed reports for all ITA employees who made charges during the period January 1994 through March 1995 and found many employees with delinquent account balances, probable personal charges, or questionable Automatic Teller Machine advances. Probable personal charges include those made within the vicinity of an employee's official duty station or charges made at vendors not normally associated with official travel expenses (jewelry, department, book, or music stores, and florists).

We gave ITA's coordinator a sample list of potentially deficient accounts and asked for additional information, such as explanations from employees and supervisors and evidence of actions taken. The coordinator made a good effort to follow up on employees with delinquent balances or questionable charges. As a result, the coordinator provided us with written or oral explanations for many items in our sample. The coordinator's actions have led to cancellation of some employees' charge cards. However, despite the coordinator's efforts, numerous questionable items were not explained. Consequently, we do not have reasonable assurance that the Department's procedures for reviewing monthly reports and following up on misuses of charge cards are being fully implemented and followed.

Attachment 1 lists employees with delinquent accounts (60 days or more past due), and Attachment 2 lists employees with probable personal charges and questionable ATM advances. We also have included sections of the American Express reports showing the delinquencies or charges in question. Please examine the specific circumstances surrounding the delinquency or personal use of the American Express card by these employees and provide us with a written explanation within 30 days. Please include a statement as to the administrative action proposed for employees who have misused the card privileges.

Also, please take action to ensure that ITA managers, supervisors, coordinators, and cardholders are thoroughly familiar with the Department's procedures for managing and using the government charge cards.

If you have any questions, please contact Andrew Cochran, Director, Economic Affairs Audit Division, on 482-0067.

Attachments

cc(without attachments):
Alan Neuschatz, Director, ITA Administration

APPENDIX V

UNITED STATES DEPARTMENT OF COMMERCE
The Inspector General
Washington, D.C. 20230

JUL - 6 1995

MEMORANDUM FOR: Dr. D. James Baker
Under Secretary and Administrator
National Oceanic and Atmospheric Administration

FROM: Frank DeGeorge
Inspector General

SUBJECT: Use of American Express Charge Cards

As a part of our audit of Department travel expenses, we reviewed the management and use of government charge cards issued by the American Express Company. We found (1) very little management and oversight of card activities and (2) evidence of massive abuse of the charge card privilege by numerous NOAA employees. As discussed below, we are recommending that you take action against individuals who have misused the American Express travel charge card for personal use.

We noted there was only one NOAA employee actually reviewing charge card use by the 5,000 to 6,000 cardholders in NOAA. Consequently, the employee cannot adequately monitor the many monthly charges and delinquencies and identify and notify the appropriate bureau managers of potential misuse. NOAA should assign this control function to as many personnel as needed to perform timely reviews of the monthly activity reports, and to identify and report possible misuse and delinquencies.

The DOC Travel Handbook limits the use of the contractor-issued government charge card to expenses incurred for officially authorized government travel. Personal use of the card is not authorized. Automatic Teller Machine cash advances and purchases made in retail stores are limited to official travel business.

Employees must sign a statement acknowledging that they have read and understand the policies and procedures related to the use of the contractor-issued travel charge card. This statement reinforces the requirement that use of the card is limited to official government travel and that personal use of the card is prohibited.

Employees also must pay their charge card bills, in full, on or before the next statement billing date. Employees are personally liable for all charges incurred. The employee responsibilities and conduct provided in 15 CFR 0.735-16 require DOC employees to make proper and timely payments for each just financial obligation. An employee's supervisor may take corrective actions (cancellation of the card and/or other administrative action) if the employee fails to pay the bill. The Department penalty guidelines for violation of this conduct standard range from a written reprimand to removal.

Managers in Department bureaus and operating units are responsible for designating certain employees to act as coordinators to administer the Government charge card program. Managers also are responsible for notifying the employee's immediate supervisor of any questionable expenditures and/or delinquencies of 60 days or more in the paymert of accounts.

The supervisor is responsible for (1) giving the employee an opportunity to explain the expenditure or delinquency, (2) maintaining a record of the discussion with the employee, (3) taking appropriate disciplinary action if the explanation is inadequate, and (4) revoking the card if there is a second instance of inappropriate use or insufficient explanation for the delinquency. Charge card coordinators are responsible for (1) monitoring the monthly charges and delinquency notices, and (2) notifying the appropriate bureau managers of possible misuse or delinquencies of 60 days or more.

We reviewed reports for NOAA employees who made charges during the period October 1994 through May 1995 and found many employees with delinquent account balances, probable personal charges, or questionable Automatic Teller Machine advances. Probable personal charges include those made within the vicinity of an employee's official duty station or charges made at vendors not normally associated with official travel expenses (liquor, jewelry, department, book or music stores, and florists). Also, we noted charges for computer on-line service fees and automobile insurance.

Attachment 1 lists employees with delinquent accounts (60 days or more past due), and Attachment 2 lists employees with probable personal charges and questionable ATM advances. We also have included sections of the American Express reports showing the delinquencies or charges in question. Please examine the specific circumstances surrounding the delinquency or personal use of the American Express card by these employees and provide us with a written explanation within 30 days. Please include a statement as to the administrative action proposed for employees who have misused the card privileges.

Please also take action to ensure that NOAA managers, supervisors, coordinators, and cardholders are thoroughly familiar with the Department's procedures for managing and using the government charge cards.

If you have any questions, please contact Andrew Cochran, Director, Economic Affairs Audit Division, on 482-0067.

Attachments

cc(without attachments):
Donald E. Humphries, Acting Director, NOAA Office of Administration

UNITED STATES DEPARTMENT OF COMMERCE
The Inspector General
Washington, D.C. 20230

JUN - 6 1995

MORANDUM FOR: Thomas R. Bloom
Chief Financial Officer and Assistant
Secretary for Administration

:OM: Frank DeGeorge
Inspector General

/BJECT: Use of American Express Charge Cards

s a part of our audit of Department travel expenses, we reviewed
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er the government charge card program. Managers also are

APPENDIX VII

UNITED STATES DEPARTMENT OF COMMERCE
Office of the General Counsel
Washington, D.C. 20230

DEC 15 1994

MEMORANDUM FOR: Secretarial Officers
Heads of Operating Units

FROM: Barbara S. Fredericks
Assistant General Counsel
for Administration

SUBJECT: Use of the Government Travel Charge Card

The attached memorandum from Robert J. Stein is a reminder of the restrictions that apply to the use of the Government travel charge card.

Pursuant to Mr. Stein's request, please distribute the memorandum to all employees of your agency or operating unit to whom the travel charge card has been issued.

cc: Administrative Officers

UNITED STATES DEPARTMENT OF COMMERCE
Office of the Secretary
Washington, D.C. 20230

DEC 15 1994

MEMORANDUM FOR: Department Employees Who Hold a Government Travel Charge Card

FROM: Robert J. Stein
Chief of Staff

SUBJECT: Restrictions on the Use of the Charge Card

This is to remind you of the restrictions that apply to your use of the Government travel charge card, which is currently issued under contract with American Express. The Government established the charge card program to provide flexibility and convenience for employees while traveling on official Government business. Use of the card for payments or purchases other than authorized travel expenditures is strictly prohibited.[1]

Please note the following guidelines concerning use of the charge card:

o Issuance of a Government travel charge card does not itself provide authority to incur expenses. The card is simply a convenient way to make payments for travel expenses which have been properly authorized.

o The card is not available for your personal use. The card is for official use only. If you incur non-authorized expenses while on official travel, you may not use the card to pay for them. It is irrelevant that the Department will not actually bear those costs because you will pay the charge card bill yourself and you do not intend to claim those expenses on your travel voucher. An exception to this restriction is where incidental personal expenses are combined with official expenses, for example, in a hotel bill, and cannot be conveniently billed separately, in such cases, you may pay the entire bill with the charge card, provided you claim only official expenses on your travel voucher.

o You may not use the card for travel expenses of family members or other private individuals who accompany you on official travel. An exception to this restriction permits use of the card for common or shared services or facilities (including rooms, meals, and the like), provided that you claim only your official portion of the charged expense on your travel voucher. Shared

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[1] A separate purchase card program (issued under contract with VISA) governs the purchase of supplies and equipment, and is distinct from the travel charge card program.

Chief Financial Officer
Assistant Secretary for Administration
Washington, D.C. 20230

SEP 27 1995

MEMORANDUM FOR Frank DeGeorge
Inspector General

FROM: Thomas R. Bloom

SUBJECT: Departmental Travel Expenses Need
Better Control and Oversight
Draft Audit Report No. EAD-7129-5-000X

We have reviewed your draft audit report on Departmental travel expenses. As we have informed your staff, additional time is required for us to complete a comprehensive analysis of the audit and to develop an action plan which appropriately addresses your recommendations. Our review allows us to generally agree with your office's findings that certain aspects of the travel program and expenses within areas of the Department require greater control and oversight. Further analysis, in consultation with the National Oceanic and Atmospheric Administration (NOAA), will specifically address your findings.

We will make every effort to complete this coordination with NOAA and provide you with a comprehensive response to the report's individual recommendations no later than November 30, 1995.

Thank you for providing us the opportunity to review the draft audit report.

services or facilities under this exception do not include airline or other common carrier tickets, and you may not use the card to purchase such tickets for private individuals who travel with you.

o As with any charge card, appropriate precautions should be taken to ensure the security of the card.

o Use of the charge card at your official duty station is strictly forbidden unless its use is in connection with official travel. Local expenses for travel may not be charged to the card unless the expenses are authorized under applicable travel regulations.

o You are responsible for prompt payment of the charge card bill. Reimbursement to you of allowable expenses charged to the card is made through the Department travel voucher process. You should make every effort to submit your travel voucher as soon as travel is completed to ensure that you will obtain reimbursement prior to the due date of the bill.

o Before leaving, retiring, or transferring to another Federal position, including transferring to another Bureau within the Department, you must return the card (cut in half) to your supervisor or your charge card coordinator for cancellation.

In addition to these guidelines, you should have received more detailed information concerning applicable policies and procedures at the time you were issued the card. We recommend you maintain a copy of this information for your reference. If you did not receive this information or you have any questions concerning the charge card program, please contact the travel charge card program coordinator for your office or operating unit, or the Departmental Coordinator at 482-1818.

APPENDIX VI

UNITED STATES DEPARTMENT OF COMMERCE
The Inspector General
Washington, D.C. 20230

JUN - 6 1995

MEMORANDUM FOR: Thomas R. Bloom
Chief Financial Officer and Assistant
Secretary for Administration

FROM: Frank DeGeorge
Inspector General

SUBJECT: Use of American Express Charge Cards

As a part of our audit of Department travel expenses, we reviewed the management and use of government charge cards issued by the American Express Company. We found (1) a need for better management and oversight of card activities and (2) evidence of abuse of the charge card privilege by several employees in the Office of the Secretary and associated administrative offices. As discussed below, we are recommending that you take action against individuals who have misused the American Express travel charge card for personal use.

The DOC Travel Handbook limits the use of the contractor-issued government charge card to expenses incurred for officially authorized government travel. Personal use of the card is not authorized. Automatic Teller Machine cash advances and purchases made in retail stores are limited to official travel business.

Employees must sign a statement acknowledging that they have read and understand the policies and procedures related to the use of the contractor-issued travel charge card. This statement reinforces the requirement that use of the card is limited to official government travel and that personal use of the card is prohibited.

Employees also must pay their charge card bills, in full, on or before the next statement billing date. Employees are personally liable for all charges incurred. The employee responsibilities and conduct provided in 15 CFR 0.735-16 require DOC employees to make proper and timely payments for each just financial obligation. An employee's supervisor may take corrective actions (cancellation of the card and/or other administrative action) if the employee fails to pay the bill. The Department penalty guidelines for violation of this conduct standard range from a written reprimand to removal.

Managers in Department bureaus and operating units are responsible for designating employees to act as coordinators to administer the government charge card program. Managers also are

responsible for notifying the employee's immediate supervisor of any questionable expenditures and/or delinquencies of 60 days or more in the payment of accounts.

The supervisor is responsible for (1) giving the employee an opportunity to explain the expenditure or delinquency, (2) maintaining a record of the discussion with the employee, (3) taking appropriate disciplinary action if the explanation is inadequate, and (4) revoking the card if there is a second instance of inappropriate use or insufficient explanation for the delinquency. Charge card coordinators are responsible for (1) monitoring the monthly charges and delinquency notices, and (2) notifying the appropriate bureau managers of possible misuse or delinquencies of 60 days or more.

We reviewed American Express Company reports, showing charge card usage by Office of the Secretary employees for the period March 17 through May 16, 1995. We found that several employees had delinquent account balances, probable personal charges, or questionable Automatic Teller Machine advances. Since the card is to be used for only official travel purposes, we considered any charges within the vicinity of an employee's duty station to be possible personal usage. Also, we noticed charges made at vendors not normally associated with official travel, such as jewelry or department stores and florists.

Attachment 1 lists employees with delinquent accounts (60 days or more past due), and Attachment 2 lists employees with probable personal charges and questionable ATM advances. We also have included sections of the American Express reports showing the delinquencies or charges in question. Please examine the specific circumstances surrounding the delinquency or personal use of the American Express card by these employees and provide us with a written explanation within 30 days. Please include a statement as to the administrative action proposed for employees who have misused the card privileges.

Also, please take action to ensure that Office of the Secretary managers, supervisors, coordinators, and cardholders are thoroughly familiar with the Department's procedures for managing and using the government charge cards.

If you have any questions, please contact Andrew Cochran, Director, Economic Affairs Audit Division, on 482-0067.

Attachments

cc(without attachments):
Sonya G. Stewart, Director Executive Budgeting and Assistance Management

UNITED STATES DEPARTMENT OF COMMERCE
Office of the General Counsel
Washington, D.C. 20230

DEC 15 1994

MEMORANDUM FOR: Secretarial Officers
Heads of Operating Units

FROM: Barbara S. Fredericks
Assistant General Counsel
for Administration

SUBJECT: Use of the Government Travel Charge Card

The attached memorandum from Robert J. Stein is a reminder of the restrictions that apply to the use of the Government travel charge card.

Pursuant to Mr. Stein's request, please distribute the memorandum to all employees of your agency or operating unit to whom the travel charge card has been issued.

cc: Administrative Officers

UNITED STATES DEPARTMENT OF COMMERCE
Office of the Secretary
Washington, D.C. 20230

DEC 15 1994

MEMORANDUM FOR: Department Employees Who Hold a Government Travel Charge Card

FROM: Robert J. Stein
Chief of Staff

SUBJECT: Restrictions on the Use of the Charge Card

This is to remind you of the restrictions that apply to your use of the Government travel charge card, which is currently issued under contract with American Express. The Government established the charge card program to provide flexibility and convenience for employees while traveling on official Government business. Use of the card for payments or purchases other than authorized travel expenditures is strictly prohibited.[1]

Please note the following guidelines concerning use of the charge card:

o Issuance of a Government travel charge card does not itself provide authority to incur expenses. The card is simply a convenient way to make payments for travel expenses which have been properly authorized.

o The card is not available for your personal use. The card is for official use only. If you incur non-authorized expenses while on official travel, you may not use the card to pay for them. It is irrelevant that the Department will not actually bear those costs because you will pay the charge card bill yourself and you do not intend to claim those expenses on your travel voucher. An exception to this restriction is where incidental personal expenses are combined with official expenses, for example, in a hotel bill, and cannot be conveniently billed separately, in such cases, you may pay the entire bill with the charge card, provided you claim only official expenses on your travel voucher.

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[1] A separate purchase card program (issued under contract with VISA) governs the purchase of supplies and equipment, and is distinct from the travel charge card program.

services or facilities under this exception do not include airline or other common carrier tickets, and you may not use the card to purchase such tickets for private individuals who travel with you.

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Chief Financial Officer
Assistant Secretary for Administration
Washington, D C 20230

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