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WEATHER SERVICE MODERNIZATION

Despite Progress, Significant Problems and Risks Remain

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Mr. Chairman and Members of the Subcommittee:

We appreciate the opportunity to testify on the National Weather Service's (NWS) modernization program--one of the larger systems modernization programs in the federal government. At a cost of about $4.5 billion, this modernization is also one of the largest programs in the National Oceanic and Atmospheric Administration (NOAA), representing about 20 percent of its total fiscal year 1996 budget request. Moreover, it is a program that is vital to NWS' plans for streamlining and improving operations and downsizing its organization, and a program that relies heavily on advanced computer technologies.

To date, NWS has made progress on the modernization. For example, despite delays caused largely by expanded system requirements and contractor performance problems, last year NWS successfully placed into orbit the first of its new weather satellites. Further, 107 of the newer, much more capable doppler weather radars are currently in use, and more continue to be installed.

Much remains to be accomplished, however, before promised modernization benefits can occur. Meeting this challenge will require NWS to address a number of known system problems as well as mitigating the risk of future problems. For example, we reported last year that the modernization has proceeded far too long without the benefit of a much needed systems architecture, or blueprint, to guide the development and evolution of the many systems comprising the modernization.[1]

In addition, preliminary results from our ongoing work for the Chairman and Ranking Minority Member of your Committee and the Senate Committee on Commerce, Science, and Transportation, show that a number of problems still need to be addressed on one of the modernization's major systems, the Automated Surface Observing System. Until they are resolved, the people that the system is intended to replace cannot be taken away without potentially risking aviation efficiency and safety, as well as skewing climate research.

Similarly, NWS is in the process of trying to place the "heart" of the modernization--the Advanced Weather Interactive Processing System--back on track after recent developments derailed it. Given the pivotal role of this system, NWS' laudable goals of field office and staff reductions and improved weather forecasts and warnings, to name a few potential benefits, will not be fully achieved until the system is implemented.

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[1]Weather Forecasting: Systems Architecture Needed for National Weather Service Modernization (GAO/AIMD-94-28, March 11, 1994).

Unless NWS addresses these and other problems and risks facing it, the program may prove more costly and time consuming than necessary, and it may fall short of its intended purpose. For these and other reasons, we are adding the NWS modernization to our list of high risk projects across government.

Background

NWS' basic mission is to provide weather and flood warnings, public forecasts, and advisories primarily for the protection of life and property. NWS' operations also support other agencies' missions and the nation's commercial interests. For example, NWS provides specialized forecasts to support aviation safety and the agricultural and marine industries.

NWS uses a variety of systems and manual processes to collect, process, and disseminate weather data to and among its network of field offices and regional and national centers. Many of these systems and processes are outdated. For example, some radar equipment currently in use dates back to the 1950s, and the information processing, display, and data communication system has been in use since the 1970s.

During the 1980s, NWS began modernizing its systems. The goals of its modernization program are to achieve more uniform weather services across the nation, improve forecasts, provide more reliable detection and prediction of severe weather and flooding, permit more cost-effective operations, and achieve higher productivity. The modernization includes four new major system development programs:

-- The Next Generation Weather Radar (NEXRAD), which is a program to acquire 163 doppler radars. These radars are expected to increase the accuracy and timeliness of warnings for severe thunderstorms, tornadoes, and other hazardous weather events. NWS estimates that the program will cost about $1.4 billion and be fully deployed by 1996. To date, 107 have been deployed.

-- The Next Generation Geostationary Operational Environmental Satellite (GOES-Next), which is a program to acquire, launch, and control five satellites for identifying and tracking severe weather events, such as hurricanes. NWS estimates that the program will cost about $2 billion. The first satellite was launched in April 1994 and the second is scheduled for May 1995.

-- The Automated Surface Observing System (ASOS), which is a program to automate and enhance the current, largely manual, methods for collecting, processing, and displaying surface weather conditions, such as temperature and precipitation, and to replace human weather observers. NWS estimates that the

program will cost about $351 million. To date, about 500 of the 868 planned ASOS units have been deployed; the rest are to be deployed by the end of 1997.

-- The Advanced Weather Interactive Processing System (AWIPS), which is to integrate for the first time satellite, radar, and other data to support weather forecaster decision-making and communications. The AWIPS workstations and network are estimated to cost $525 million and expected to be fully deployed in 1999.

The modernization also includes upgrades to existing systems and several smaller system acquisitions. The total cost of the modernization is estimated to be about $4.5 billion.

In association with the modernization program, NWS also plans to restructure its field offices. As envisioned, this restructuring will consolidate the current field structure of 52 Weather Service Forecast Offices, about 200 smaller Weather Service Offices, 13 River Forecast Centers, and 3 National Centers into 118 Weather Forecast Offices, 13 River Forecast Offices,[2] 13 Data Collection Offices, and 9 National Centers.

Three other agencies are participating with NWS in the modernization. The Federal Aviation Administration (FAA) and Department of Defense have formed tri-agency programs with NWS to manage and fund the development and deployment of both NEXRAD and ASOS. The National Aeronautics and Space Administration is managing the development and procurement of GOES-Next.

NWS Has Made Progress on the Modernization

To NWS' credit, parts of the modernization are partially deployed and operating, and the performance of some of these deployed systems is reported to be far superior to that of the systems they replaced. The first GOES-Next, for example, is providing improved imagery that NWS has found to be instrumental in tracking the recent weather patterns over the Pacific Ocean that were responsible for huge amounts of precipitation over California. Similarly, NWS reported that the NEXRADs have performed superbly during severe weather conditions, such as in identifying and tracking tornadoes. Further, the steps NWS took to refine and validate user requirements for AWIPS effectively involved users, used extensive prototyping, and provided that program a quality starting point from which to build.

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[2]The 13 River Forecast Offices are to be co-located with 13 of the Weather Forecast Offices.

We would now like to focus on some of the known problems and future risks facing NWS on the modernization.

NWS Modernization Still Without a Guiding Systems Blueprint

First, the modernization, which is basically a system of interrelated, interdependent systems, is still in need of a guiding systems blueprint. Collectively, its individual systems will comprise a single weather forecasting and warning "mega-system," with each component being expected to fulfill its part of the total forecasting and warning process. Because of this level of system integration, it is paramount that the development and evolution of the component systems proceed according to a common set of rules and standards that are typically promulgated in a system architecture or blueprint. To do less invites system inefficiencies, incompatibilities, and more difficult and costly maintenance.

Last year we reported that the NWS modernization lacked a systems architecture and recommended that one be developed.[3] NWS agreed with this recommendation. While we are encouraged that steps are underway to develop one, we are disappointed that the priority NWS has assigned to it means that it will take over 3 years to accomplish.

ASOS Problems Have Forced Postponement of System Commissionings and Observer Releases

Next, our ongoing work on ASOS for the full Committee and its counterpart in the Senate shows that the system is not fully performing as specified or expected. While some sensors are working as specified, others are not. For example, the precipitation accumulation sensor underreports rainfall during heavy downpours, ASOS' reliability during 1994 winter testing was about half of that required, and one-sixth of the data transmitted during 1994 between FAA ASOS sites and the ASOS monitoring organization were lost. NOAA and NWS are aware of these shortfalls and are taking steps to correct them.

Our ongoing work also shows that ASOS is not providing certain information that traditional observing methods now provide and that users say is important. For example, professional aviation organizations state that they need visibility and cloud height observations that are more representative of prevailing conditions

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[3]Weather Forecasting: Systems Architecture Needed for National Weather Service Modernization (GAO/AIMD-94-28, March 11, 1994).

than ASOS currently provides in order to efficiently and safely conduct aviation operations.

Because of the volume and severity of ASOS' problems, NWS has temporarily halted commissioning any more ASOS units and has delayed the release of human weather observers.[4] However, NWS has not decided what problems must be addressed before further commissionings can occur. Further, although NWS plans to collaborate closely with aviation users in making decisions on releasing observers, its plans do not appear to extend to other users, such as climatologists. Also, it does not yet know which problems can be cost effectively addressed. Therefore, we believe that NWS must ensure that it effectively involves all users in the decision making process and assesses the cost effectiveness of any ASOS enhancements or supplements before investing in them. We plan to make recommendations to the Secretary of Commerce on this in our upcoming report on ASOS.

Risks and Uncertainties Surrounding AWIPS Remain

Finally, since awarding a contract in December 1992, NWS has made little progress on AWIPS, the "linch pin" of the modernization. After more than 2 years, NWS still does not have an approved system design and the contractor has yet to begin writing the software. Several things led to this situation. According to the results of an independent review team of government and industry experts, AWIPS suffered from (1) insufficient technical expertise within the NOAA program office and the contractor, which has led to inadequate system engineering and software development discipline, (2) insufficient interaction among the NOAA program office, the contractor, and NWS, (3) inappropriate assignment of certain software development activities to the contractor rather than to NWS, and (4) unsuitability of the chosen system development approach.

To address the panel's findings, NOAA is restructuring the AWIPS program and plans to have an approved system design and renegotiate the AWIPS contract by June 1995. Generally, the restructured program provides for an incremental approach to developing and deploying AWIPS, strengthened contractor system engineering and software development processes, greater use of government expertise in developing the applications software (that is, the software that performs the meteorological and hydrological analyses associated with weather and river forecasting), and new contractor and NOAA management teams. The cost and schedule effect of AWIPS' problems to date and its restructuring are estimated to increase program

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[4]Of the 868 ASOS units planned, 617 have been bought, 491 of these have been installed and accepted, and 47 have been commissioned. An ASOS unit is commissioned when it, rather than a human observer, provides the official weather observation.

costs to about $525 million, $58 million more than NWS estimated in 1992, and to delay full system deployment to 1999, one year longer than NWS estimated in 1992.

While our preliminary inquiries appear to indicate that NOAA and NWS have taken reasonable action to correct AWIPS program management problems, we remain cautious. AWIPS is an enormously difficult undertaking and its development has barely begun, making its remaining development cycle still quite long and thus subject to considerable risk and uncertainty.

Accordingly, we plan to continue working with the Congress to assess NWS' management of AWIPS' inherent risks. One such risk is the relative immaturity of in-house software development processes. As mentioned above, under the restructuring, NOAA and NWS laboratories will develop AWIPS application software. However, we recently reported that these laboratories lack adequate software development processes for doing so.[5] NOAA and NWS agreed with our findings and stated that they plan to upgrade these processes as part of the restructuring.

Another risk area is the technical and legal impact of the contractor and the government sharing responsibility for the development of AWIPS. In our 1993 report on AWIPS, we raised this as a risk that needed to be addressed before the AWIPS design was approved and significant software development began.[6] Today, this remains outstanding.

Still another risk is the fact that the AWIPS design has not yet been approved. Without an acceptable design, NWS cannot move forward on AWIPS, which in turn delays the entire modernization. Other potential risk areas include the degree to which the incremental development approach (1) permits one software increment to begin before the previous software increment is stabilized and (2) does not require each software increment to be based on explicit cost/benefit criteria before its development begins.

In conclusion, we support NWS in its efforts to modernize its systems. If executed properly, the modernization will improve the quality of the agency's products and services, while at the same time streamline and downsize operations. Moreover, despite some setbacks along the way, we believe the modernization can boast of some successes. The NEXRAD radars, for example, represent a "quantum leap" in capability over the radars they are replacing.

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

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

The modernization, however, is far from over and the challenges that remain are formidable. If the modernization is to achieve its potential, known system problems, such as those plaguing ASOS, must be overcome, and future system development risks, such as those facing AWIPS, must be effectively managed. Further, the modernization's many interrelated and interdependent systems must be developed and evolved according to a detailed blueprint, such as that offered by a systems architecture. Without addressing these challenges, the modernization runs the risk of being just another good idea that never reached its potential.

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

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