

GAO

Testimony

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

---

For Release on Delivery  
Expected at  
10 a.m.  
Wednesday,  
March 4, 1998

NATIONAL WEATHER  
SERVICE

Budget Events and  
Continuing Risks of  
Systems Modernization

Statement of Joel C. Willemsen  
Director, Civil Agencies Information Systems  
Accounting and Information Management Division



---

---

---

Mr. Chairman and Members of the Subcommittee:

We are pleased to be here today to discuss our work regarding events surrounding the fiscal year 1997 budget of the National Weather Service (NWS), a component of the National Oceanic and Atmospheric Administration (NOAA) within the Department of Commerce. Our report on the matter is being released at this hearing.<sup>1</sup> We will also be reporting on the status of information first presented to this Subcommittee in 1995 on the Advanced Weather Interactive Processing System (AWIPS), a major component of the Weather Service's systems modernization program.<sup>2</sup> Finally, we will briefly update another report on the Weather Service issued last year, dealing with radar and weather service coverage to northwestern Pennsylvania with the closure of the Erie weather service office.<sup>3</sup>

---

## NWS Fiscal Year 1997 Budget "Shortfall"

The Weather Service was able to operate within its appropriated fiscal year 1997 budget level, but had to do so with fewer funds than in fiscal year 1996; NWS referred to this difference in available funds as a budget "shortfall." The "shortfall" was reported in different amounts at different points in time, such that some members of Congress experienced confusion as to the actual amount. Erroneous assumptions and miscommunication between the Weather Service and NOAA further clouded the issue.

The differing "shortfall" amounts reported to Congress depended upon definition as well as time. Congressional staff briefed in February 1997 were told that the "shortfall" amount was \$27.5 million; 2 months later, the figure had risen to \$42.2 million. Finally, at a hearing last May, the amount given was \$47.4 million. NOAA and NWS officials explained the discrepancy by saying that the varying amounts responded to specific questions at particular points in time, and did not necessarily include all known elements of the "shortfall."

Two events associated with the "shortfall" and potential ways to accommodate it raised concerns among department officials. The first

---

<sup>1</sup>National Weather Service: Events Surrounding Fiscal Year 1997 Budget (GAO/AIMD-98-69, Mar. 4, 1998).

<sup>2</sup>Weather Service Modernization: Despite Progress, Significant Problems and Risks Remain (GAO/T-AIMD-95-87, Feb. 21, 1995).

<sup>3</sup>National Weather Service: Modernization Activities Affecting Northwestern Pennsylvania (GAO/AIMD-97-156, Sept. 26, 1997).

---

centered on a Weather Service request that NOAA reprogram funds—and NWS’ intention to fill critical field office vacancies before approval of that request. While NWS counted on such approval and the availability of funds for these positions, NOAA, however, informed Weather Service officials that the vacancies could not be filled because the reprogramming request had not yet been approved.

The second event involved NWS’ attempt to obtain NOAA certification approval to consolidate, automate, and/or close weather service offices. Before any NWS office can be closed, the Secretary of Commerce must certify that the affected geographic areas will not experience a degradation of weather service. Upon learning that it would not be able to fill critical field vacancies, NWS recommended to NOAA that selected certification packages—27 out of 83—be held back because, according to a Weather Service official, not filling the vacancies would result in degraded weather services at some locations. NOAA subsequently held back all certification packages.<sup>4</sup>

On June 25, 1997—just 5 days after NWS’ Deputy Assistant Administrator for Modernization recommended holding back the 27 packages certifying nondegradation of service—NOAA’s Assistant Administrator for Weather Services was reassigned. This action was taken by NOAA’s Under Secretary, citing conflicting information from NWS on how it would provide essential weather services while recognizing the need for government agencies to reduce costs.

In addition, a special adviser was tasked with reporting to the Secretary of Commerce on the fiscal requirements to operate a modernized NWS during fiscal years 1998 and 1999. One result of the report is the department’s plan to hire a Chief Financial Officer for NWS.

---

## Weather Service Modernization and the Advanced Weather Interactive Processing System

The mission of the National Weather Service is of critical importance to all Americans—a fact of which we are reminded whenever hurricanes, floods, tornadoes, or other severe weather threatens. The service’s modernization program—vital to improved operations—is one of the largest in the federal government.<sup>5</sup> Begun in the early 1980s, its goals are to (1) achieve more uniform weather services nationwide, (2) improve forecasting, (3) provide more reliable detection and prediction of severe weather and flooding,

---

<sup>4</sup>We recently learned that NWS plans to forward about 80 certification packages this year.

<sup>5</sup>See National Oceanic and Atmospheric Administration: Weather Service Modernization and NOAA Corps Issues (GAO/T-AIMD/GGD-97-63, Mar. 13, 1997).

---

(4) permit more cost-effective operations, and (5) achieve higher productivity.

The Advanced Weather Interactive Processing System—AWIPS—is the linchpin of the NWS modernization that will integrate—for the first time—satellite, radar, and other data to support forecaster decision-making and communications. Along with AWIPS, the modernization includes three other major programs: the Automated Surface Observing System, the Next Generation Geostationary Operational Environmental Satellite (GOES-Next), and the Next Generation Weather Radar (NEXRAD).

Ongoing problems—both developmental and operational—have, however, surrounded the modernization. For example, new radars have not always been up and running when severe weather threatened, and ground-based sensors have fallen short of performance and user expectations. Performance problems such as these, along with developmental problems relating to cost and schedule, have led us to voice continuing concern—and make specific recommendations—over the past several years.<sup>6</sup> Many of these concerns remain.

As a result of its continuing problems, Weather Service modernization has been included—both in 1995 and 1997—on our list of high-risk government programs.<sup>7</sup> One key element of risk is the lack of an overall systems architecture—a guiding blueprint to be followed in the development of a systems modernization to ensure interoperability and cost-effective maintenance. As of now, an overall modernization architecture is not expected before September 30 of this year.

Through AWIPS—designed to be the “central nervous system” of a modernized Weather Service—NWS expects to tap a reservoir of data from its new observing systems, data that its current, aging system cannot handle. AWIPS forecaster workstations are being developed incrementally,

---

<sup>6</sup>See *Weather Service Modernization: Risks Remain That Full Systems Potential Will Not Be Achieved* (GAO/T-AIMD-97-85, April 24, 1997), *Weather Forecasting: Recommendations to Address New Weather Processing System Development Risks* (GAO/AIMD-96-74, May 13, 1996), *Weather Forecasting: NWS Has Not Demonstrated That New Processing System Will Improve Mission Effectiveness* (GAO/AIMD-96-29, Feb. 29, 1996), *Weather Forecasting: Improvements Needed in Laboratory Software Development Processes* (GAO/AIMD-95-24, Dec. 14, 1994), and *Weather Forecasting: Systems Architecture Needed for National Weather Service Modernization* (GAO/AIMD-94-28, Mar. 11, 1994).

<sup>7</sup>High-Risk Series: An Overview (GAO/HR-95-1, February 1995) and *High-Risk Series: Information Management and Technology* (GAO/HR-97-9, February 1997).

---

in a series of six modules called “builds.”<sup>8</sup> Operational testing and evaluation was recently concluded on build 3 and the results showed that users have generally been pleased with system modules already in use. Yet full utilization of data from the observing systems has been prevented by the continuing problems and delays. Therefore, exactly when AWIPS will be fully deployed and functioning properly, at what cost, and with what level of capability, remain unknown. Until that time, the Weather Service will not fully reap the rewards of an investment that has spanned 15 years and is approaching \$4.5 billion.

Although AWIPS is expected to greatly improve NWS’ ability to provide weather services, serious risks continue to be associated with the system’s costs, schedule, development, and maintenance. The area of cost, for example, has been in flux. The cost to develop AWIPS was estimated at \$350 million in 1985.<sup>9</sup> A decade later the figure had risen to \$525 million; however, in testimony and a report issued in 1996, we pointed out the inaccuracy of this estimate due to the omission of several cost factors, including known contract increases.<sup>10</sup> The Department of Commerce later committed to a \$550 million funding cap. We testified last spring that it would be extremely difficult for NOAA to develop and deploy AWIPS within the \$550 million cap if it encounters any major problems.<sup>11</sup> And given the size and complexity of the development—and recognizing that even managed risks can turn into real problems—such problems are likely to occur.<sup>12</sup>

The department has since reported its uncertainty over whether AWIPS could be completed within the \$550 million cap. NWS officials attribute this to increased software development expenses. In accordance with a recommendation we made in 1996,<sup>13</sup> Commerce contracted for an independent cost estimate. According to this February 2, 1998, assessment, the likely costs to complete builds 4 through 6 will jump by

---

<sup>8</sup>Incremental systems development entails building and testing software products in a series of increments with increasing functional capability; that is, the software is partitioned into increments whose development is phased in over the total development cycle.

<sup>9</sup>Weather Forecasting: Cost Growth and Delays in Billion-Dollar Weather Service Modernization ([GAO/IMTEC-92-12FS](#), Dec. 17, 1991).

<sup>10</sup>Weather Forecasting: New Processing System Faces Uncertainties and Risks ([GAO/T-AIMD-96-47](#), Feb. 29, 1996) and [GAO/AIMD-96-74](#), May 13, 1996.

<sup>11</sup>[GAO/T-AIMD-97-85](#), April 24, 1997.

<sup>12</sup>National Oceanic and Atmospheric Administration: Follow-up on Weather Service Modernization and NOAA Corps Issues ([GAO/AIMD/GGD-97-75R](#), April 10, 1997).

<sup>13</sup>[GAO/T-AIMD-96-47](#), Feb. 29, 1996 and [GAO/AIMD-96-74](#), May 13, 1996.

---

\$68 million, to a total of \$618 million. The contractor also noted a likely 9-month schedule delay.

In addition, while AWIPS was planned for full deployment through build 6 in 1999—at 152 locations nationwide—that schedule is now in doubt. The latest schedule calls for build 4—actually build 4.2—to be completed in March of 1999. Completion dates for builds 5 and 6 are now uncertain because, we are told, NWS wants to ensure that requirements for those modules are not extraneous to mission needs, in order to minimize future cost increases. This reflects a recommendation we made in 1996 for all AWIPS builds.<sup>14</sup> Until this process has been completed and specific mission requirements identified, the Weather Service will not know what capabilities builds 5 and 6 will possess, and when they will be available.

The most critical risk factors underlying questions about AWIPS' future relate to software development. Software quality is governed largely by the quality of the processes used to develop it; however, NWS' efforts to develop AWIPS software have lacked defined software-development processes. Such processes are all the more essential because of NWS' increased use of software code developed internally at NOAA's Forecast Systems Laboratory (FSL) in Boulder, Colorado—a research and development facility that primarily develops prototype systems.<sup>15</sup> This software code has not been developed according to the rigorous processes commonly used to develop production-quality code.<sup>16</sup> Failure to adhere to these processes may result in unstable software that will continue to cause cost increases and schedule delays. The cost assessment delivered last month also found risk inherent in the development of builds 4 through 6 because of the transitioning of FSL-developed software to AWIPS, and the uncertainty surrounding requirements for these builds.

Another risk area concerns the network control facility, which provides the ability to monitor and maintain AWIPS sites across the country from a single location. Through build 3 AWIPS was still experiencing difficulty with the central location's ability to detect and respond to problems. We should

---

<sup>14</sup>See [GAO/AIMD-96-29](#), Feb. 29, 1996.

<sup>15</sup>FSL's prototype system, called Weather Forecast Office (WFO)-Advanced, was being developed in parallel with AWIPS as a risk-reduction tactic. In both 1995 and 1996, AWIPS program officials decided to use the WFO-Advanced software to take advantage of FSL's hydrology and meteorology application software, hoping that this would enable NWS to deploy AWIPS as quickly as possible.

<sup>16</sup>See [GAO/T-AIMD/GGD-97-63](#), Mar. 13, 1997, and [Weather Forecasting: Improvements Needed in Laboratory Software Development Processes \(GAO/AIMD-95-24](#), Dec. 14, 1994) for discussion of software quality assurance and software configuration management principles typical of a production environment.

---

note, however, that such problems concerned only a limited number of sites, and that as more sites come on line, problems can be expected to increase. Weather Service officials acknowledged that the poor performance of the network control facility to date is a prime concern, and that neither NWS nor its contractor has experience in developing the capability for central maintenance. As a result, they told us that they obtained a contractor to assist them in this area.

The last, huge area of risk, inescapably, is whether the AWIPS builds—and, indeed, all modernization components—will be what is called Year 2000 compliant.<sup>17</sup> On the basis of information received from Weather Service officials just last week, our concerns have not been allayed. AWIPS to date is not Year 2000 compliant. Build 4.2—set for completion a year from now—is supposed to make all AWIPS applications Year 2000 compliant. But several questions remain, perhaps the most obvious: What if it does not? As a fail-safe tactic, NWS told us that it has renovated its aging current system, Automation of Field Operations and Services, in case AWIPS is not operational by the year 2000.

Yet even if Year 2000 compliance ceases to be an issue with build 4.2, NWS' companion modernization systems—GOES-Next, and NEXRAD—will need to be compliant as well because of the amount of data interchanged among them. Similarly, it will be essential to determine whether all systems that provide data to individual weather stations are themselves Year 2000 compliant; otherwise, “corrupted” data emanating from an unrenovated system could infect the entire operation. According to NWS officials, they are continuing to evaluate their data exchanges. They also acknowledged the risks to weather services if their systems are not Year 2000 compliant. To reduce the risk and the potential impact of Year 2000-induced information system failures on the Weather Service's core business processes, it is critical that NWS have contingency plans in place to help ensure continuity of operations through the turn of the century.

---

<sup>17</sup>Computer systems have long used two digits to represent the year, such as simply “98” for 1998, to conserve electronic data storage and reduce operating costs. In this format, however, 2000 is indistinguishable from 1900 because both are represented as “00.” As a result, if not modified, systems or applications that use dates or perform date- or time-sensitive calculations may generate incorrect results beyond 1999.



---

## Erie/Northwestern Pennsylvania Radar Coverage

Finally, at the request of the Chairman of the full Committee and Congressman English, we reported last September on the effects of NWS modernization activities on radar coverage in the area of Erie and northwestern Pennsylvania.<sup>18</sup> As part of its streamlining efforts, the Weather Service has identified various weather offices nationwide for closure, with responsibilities to be taken over by neighboring offices. Many concerns were voiced, however, that closing the Erie office would result in a gap in radar coverage of lake-effect snow—a gap that neighboring NWS offices (in Cleveland, Buffalo, Pittsburgh, and State College, Pennsylvania) would be unable to fill.

As we reported at the time, several studies presented evidence that a degradation in weather service had not occurred in northwestern Pennsylvania; however, the ability to detect and predict lake-effect snow remained a concern. For example, the preliminary conclusions of an NWS lake-effect snow study indicated that weather services provided to Erie were not as good as services provided to other lake communities whose overall service had improved as a result of the NWS modernization. Because of this, the Director of NWS' Office of Meteorology recommended that a new radar be installed for the Erie area.

In its response at the time, Commerce officials said they were still in the process of completing the study of lake-effect snow and reviewing the need for additional radar at Erie. As of last week, however, no decision on this matter had been made.

---

Mr. Chairman, this concludes my statement. We would be pleased to respond to any questions that you or other members of the Subcommittee may have at this time.

---

<sup>18</sup>GAO/AIMD-97-156, Sept. 26, 1997.

---

### Ordering Information

The first copy of each GAO report and testimony is free. Additional copies are \$2 each. Orders should be sent to the following address, accompanied by a check or money order made out to the Superintendent of Documents, when necessary. VISA and MasterCard credit cards are accepted, also. Orders for 100 or more copies to be mailed to a single address are discounted 25 percent.

**Orders by mail:**

**U.S. General Accounting Office  
P.O. Box 37050  
Washington, DC 20013**

**or visit:**

**Room 1100  
700 4th St. NW (corner of 4th and G Sts. NW)  
U.S. General Accounting Office  
Washington, DC**

**Orders may also be placed by calling (202) 512-6000  
or by using fax number (202) 512-6061, or TDD (202) 512-2537.**

**Each day, GAO issues a list of newly available reports and testimony. To receive facsimile copies of the daily list or any list from the past 30 days, please call (202) 512-6000 using a touchtone phone. A recorded menu will provide information on how to obtain these lists.**

**For information on how to access GAO reports on the INTERNET, send an e-mail message with "info" in the body to:**

**[info@www.gao.gov](mailto:info@www.gao.gov)**

**or visit GAO's World Wide Web Home Page at:**

**<http://www.gao.gov>**

---

**United States  
General Accounting Office  
Washington, D.C. 20548-0001**

**Bulk Rate  
Postage & Fees Paid  
GAO  
Permit No. G100**

**Official Business  
Penalty for Private Use \$300**

**Address Correction Requested**

---