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April 10, 1997

The Honorable Ken Calvert  
Chairman  
Subcommittee on Energy and Environment  
Committee on Science  
House of Representatives

Subject: National Oceanic and Atmospheric Administration: Follow-up on  
Weather Service Modernization and NOAA Corps Issues

Dear Mr. Chairman:

In response to your March 19, 1997, letter, we are providing the enclosed responses to questions submitted by Members of the Subcommittee following our March 13, 1997, testimony on various National Oceanic and Atmospheric Administration (NOAA) issues. These responses cover two National Weather Service (NWS) modernization projects--the Advanced Weather Interactive Processing System (AWIPS) and the Geostationary Operational Environmental Satellite program (GOES)--and the NOAA Commissioned Corps. The basis for our responses is our testimony, National Oceanic and Atmospheric Administration: Weather Service Modernization and NOAA Corps Issues (GAO/T-AIMD/GGD-97-63, March 13, 1997), and recent reports on GOES, Weather Satellites: Planning for the Geostationary Satellite Program Needs More Attention (GAO/AIMD-97-37, March 13, 1997), and the NOAA Commissioned Corps, Federal Personnel: Issues on the Need for NOAA's Commissioned Corps (GAO/GGD-97-10, Oct. 31, 1996).

If you or your staff have further questions or would like to discuss our responses in more detail, please call me at (202) 512-6253.

Sincerely yours,

Joel C. Willemssen  
Director, Information Resources Management

Enclosure

RESPONSES TO QUESTIONS ON AWIPS, GOES, AND THE NOAA CORPS

Following are questions asked by the Members of the Subcommittee on Energy and Environment and GAO's responses.

**Question 1: Has the National Oceanic and Atmospheric Administration (NOAA) adequately assessed the risks of integrating Weather Forecast Office (WFO)-Advanced into the Advanced Weather Interactive Processing System (AWIPS)?**

**GAO Response 1:** NOAA officials acknowledge that integrating WFO-Advanced software into AWIPS is a large, complex task because the software is supplying a major portion of AWIPS functionality. NOAA officials also acknowledge that there are risks in this process and have taken steps to help minimize these risks. For example, as we discussed on pages 3 and 4 of our testimony, the NOAA laboratory developing WFO-Advanced did not have the software quality assurance and configuration management processes sufficient to ensure production of stable, reliable software code.<sup>1</sup> To improve on the laboratory-developed software, NOAA has issued task orders to the contractor to more fully document the design and software code used in WFO-Advanced. In addition, NOAA has developed a configuration management plan that will help ensure control over changes to the software. Page 4 of our testimony describes other steps NOAA plans to take to help manage risks.

It should be noted, however, that many of these steps have not yet been fully implemented. In addition, even with risk mitigation plans in place, risks still often turn into problems that typically incur cost overruns and schedule delays. As we noted on page 5 of our testimony, NOAA does not have any cost or schedule allowances to absorb any delays or cost increases.

**Question 2: Is the division of future work responsibilities among the National Weather Service, the Forecast Systems Laboratory, and the contractor reasonable?**

**GAO Response 2:** The strategy NOAA has chosen--dividing work among NOAA/NWS, NOAA/NWS labs, and the contractor--optimizes the skills and strengths of each player and is probably its best route for trying to keep AWIPS on schedule. NOAA officials

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<sup>1</sup>National Oceanic and Atmospheric Administration: Weather Service Modernization and NOAA Corps Issues (GAO/T-AIMD/GGD-97-63, March 13, 1997).

recognize that designing AWIPS is not an easy task, and that it was probably unrealistic to expect a contractor to have the "corporate knowledge"--the understanding of operational weather forecasting and complex meteorological processes--necessary for successfully designing such a system. The decision to use WFO-Advanced was prompted by the more advanced and fully developed capabilities of the system over the contractor-developed software, and NOAA officials hoped that using it would enable them to provide needed capabilities to forecasting offices sooner. Managing the division of responsibilities among the involved parties is, however, a significant task; therefore, effective and frequent communication and teamwork among all players is essential to the success of AWIPS.

**Question 3: What are some of the issues that still need to be addressed if NOAA is to develop and deploy the system within the new \$550-million cap?**

**GAO Response 3:** It will be extremely difficult for NOAA to develop and deploy AWIPS within the \$550-million cap if it encounters any major problems. However, given the size and complexity of the development and recognizing that even managed risks can turn into problems, such problems are likely to occur. AWIPS has experienced serious schedule delays and cost overruns in the past.

To minimize any surprises that may occur with the remaining development and deployment work, we see two issues that need attention. First, NOAA management and the modernization team need to be vigilant for potential problems in the remaining development work. Getting WFO-Advanced and other government-furnished software up to production-level quality is essential. Government-furnished software should be fully tested to ensure that it causes no complications when integrated with other AWIPS software. Any potential problems should be communicated to senior NOAA management and congressional oversight committees. The modernization team, NOAA management, and the oversight committees should work together to devise the most expeditious and cost-effective solutions to any problems that arise.

The second remaining issue for the AWIPS development is for NOAA to renegotiate the contract for AWIPS "builds" 4 through 6. While NOAA officials have told us that major cost and/or schedule changes are not expected, this is not a guarantee that these changes won't occur. The renegotiation should be carried out expeditiously, guarding against any unnecessary changes; progress should be communicated to senior NOAA management and the oversight committees.

**Question 4: What is the danger in NOAA's continuing to buy gap-filler satellites indefinitely?**

**GAO Response 4:** Gap-filler satellites (the "GOES continuation series") represent technology and user requirements that were defined more than a decade ago. A lot has changed since then. Technology now exists that can improve the efficiency and capabilities of both the GOES instruments and the spacecraft. By continuing to buy gap-filler satellites, NOAA will be missing the opportunity to take advantage of this technology. By reexamining the architecture, user requirements, and technology of the GOES system, NOAA may well be able to develop a significantly more capable and more cost-effective system.<sup>2</sup>

**Question 5: Does the current GOES imager produce data quickly enough to meet the needs of forecasters who are tracking severe weather, such as the storms that struck Arkansas, Kentucky, and Tennessee on March 1? Wouldn't more frequent GOES images be useful?**

**GAO Response 5:** According to NOAA and National Aeronautics and Space Administration (NASA) officials, forecasters at NWS offices could use more frequent GOES images to better predict the exact course of severe storms, such as hurricanes, thunderstorms, and tornadoes. For example, at the time of the severe tornado activity on March 1, frequent "rapid-scan" GOES images could have helped to more precisely determine where the storm activity was heading and perhaps enable issuance of a tornado warning earlier than the one-half hour advance warning that was achieved. In this particular case, the storm was very well "marked," meaning that it was not difficult to predict its course. NOAA officials told us that forecasters were able to use NEXRAD<sup>3</sup> radar data at the local weather office level to track the storm and make predictions. Tracking of a less well-marked storm would have benefited more from frequent (rapid-scan) GOES images, which would have shown where the overall storm system was headed and how it was developing. Having said this, however, it must be noted that none of the weather offices in the affected area are yet equipped with AWIPS stations. Because of this, it would have been impossible for them to receive GOES rapid-scan data, even if it had been produced.

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<sup>2</sup>See Weather Satellites: Planning for the Geostationary Satellite Program Needs More Attention (GAO/AIMD-97-37, March 13, 1997).

<sup>3</sup>NEXRAD, or Next Generation Weather Radar, is a Doppler radar used to determine the speed and direction of rain or snow particles, cloud droplets, or dust moving toward or away from the radar. NEXRAD is one of the major systems developed under the NWS modernization program.

The GOES imager has the technical capability of producing images of small areas, such as adjoining states, at 1-minute intervals. This capability was demonstrated during the on-orbit check-out periods of GOES-8 and GOES-9 spacecraft. However, it is not part of normal operations because it would prevent other required observations. If such a capability were regularly available, it would greatly improve the ability to predict the onset, location, movement, and rapid changes associated with severe weather events.

**Question 6: What is your assessment of the utility of the GOES sounder?**

**GAO Response 6:** Although sounders have flown on GOES spacecraft since 1980, geostationary sounder data have seen little operational use to date. This is in marked contrast to data from the imager, which are vitally important for tracking severe weather. However, it is difficult to draw definitive conclusions. Researchers have made much progress in experimenting with GOES sounder data and, as of this past February, sounder data are now being used operationally as input to at least one of the standard analyses that are performed by NWS using its prediction models. NOAA officials with whom we spoke believe that greater experience with the sounder will yield important uses for the data in the future. Now, however, the sounder remains far less important than the imager, which is still increasing in importance to forecasters.

**Question 7: Would it be useful to resurrect NASA's old Operational Satellite Improvement Program (OSIP) as a way of advancing technology for the GOES program?**

**GAO Response 7:** OSIP and its predecessor projects at NASA were vehicles through which NASA developed early versions of both the GOES system and NOAA's polar-orbiting satellite system. The NASA-developed satellites gave NASA and NOAA the opportunity to gain experience in operating meteorological satellites and analyzing their observations on an experimental basis. NASA's elimination of OSIP left NOAA without the engineering support required to design, develop, and test new spacecraft and instrument technologies before incorporating them into the agency's operational satellite systems. However, it may not be necessary to reinstate OSIP as such in order to receive these benefits. NASA has several avenues within its existing programmatic structure for undertaking research and demonstration projects related to advanced weather satellites. For example, this past February NASA initiated an advanced geostationary studies program to pursue the development of new experiments, such as the Geostationary Advanced Technology Environmental System (GATES). Currently all initiatives, including this one, are limited to exploratory studies. Neither NOAA nor NASA have committed for longer term funding for early experiments or flight demonstrations at this time.

**Question 8: Although the NOAA Commissioned Corps is a uniformed service, please describe how the NOAA Corps differs from military service.**

**GAO Response 8:** NOAA Corps members' entitlement to military ranks and military-like compensation, including eligibility for retirement at any age after 20 years of service, was an outgrowth of temporary service with the armed forces during World Wars I and II. Even though the Corps has not been incorporated into the armed forces since World War II, it has retained virtually the same pay and benefits as the military, including retirement. NOAA Corps members, however, are not subject to the Uniform Code of Military Justice, which underlies how military personnel are managed, and can quit the Corps without legal sanctions. We discuss differences between the NOAA Commissioned Corps and military service on pages 5 and 6 of our report, Federal Personnel: Issues on the Need for NOAA's Commissioned Corps (GAO/GGD-97-10, Oct. 31, 1996).

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