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Space debris: A growing challenge
A conversation with Graham Love

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Cloudy

The National Polar Orbiting Environmental Satellite System has become increasingly important to our ability to predict weather and monitor climate trends. But technical troubles, funding issues, and an unworkable management structure severely threaten this once-promising program. If corrective actions are not taken soon, a serious gap in coverage and a degraded forecasting capability appear inevitable.



The future looks forbidding for space-based weather forecasting and climate monitoring. Big problems have beset the development of advanced polar orbiting environmental satellites designed to meet both military and civilian needs. The stakes are high for the U.S., and solutions are not in sight.

At issue is the troubled National Polar Orbiting Environmental Satellite System (NPOESS). By all accounts, its timely deployment will be critical to improving and maintaining the continuity of meteorological and climatological data from space. Experts expect it to become ever more important in the years ahead as the U.S. and other nations take measures to control global warming and keep the climate on an even keel.

Early promise dims

NPOESS once showed high promise. The program was created to develop and produce six satellites with highly advanced, state-of-the-art sensors and instruments for measuring and disseminating data on weather and climate. NPOESS was ex-

forecast

for NPOESS



pected to generate extraordinarily accurate long-range and short-range weather forecasts. The constellation's high-speed communications links would give meteorologists on the ground the added advantage of almost instant access to weather and climate data from space, experts believed.

NOAA claimed that the NPOESS satellites would collect "a massive amount of very precise Earth-surface, atmospheric, and space environmental measurements from a variety of onboard sensors."

From the outset, one major attraction of NPOESS was its incorporation of Raytheon's advanced visual/infrared imager radiometer suite (VIIRS), designed to see through clouds. Military strategists and tacticians found it enticing. So did hurricane forecasters. But VIIRS

ran into technical, weight, and cost problems. It seems to be doing somewhat better now but remains problematic, officials say.

NPOESS began faltering years ago. Its ever-worsening problems sounded alarms in Congress and elsewhere early in this decade, and engendered hearings, investigations, and remedial actions. Because of financial, administrative, and technical difficulties, the program was restructured in 2006, with the planned number of satellites reduced from six to four, and onboard subsystems and sensors cut from 13 to nine. Four of the remaining sensors are said to be less capable than before.

The NPOESS schedule has slipped by at least six years. Cost has doubled to approximately \$14 billion, and is expected to grow by at least another \$1 billion and counting.

by James W. Canan
Contributing writer

The 2006 restructuring did not do the trick. In its aftermath, “the program is still encountering technical issues, schedule delays, and the likelihood of further cost increases,” says a General Accountability Office report. It notes that the schedules for the NPOESS Preparatory Project (NPP) demonstration satellite and the first two NPOESS satellites are expected to be delayed by seven, 14, and five months, respectively. These delays, GAO says, “have endangered our nation’s ability to ensure the continuity” of weather and climate data from polar-orbiting satellites.

In July, in an attempt to salvage the satellite, the Obama administration pumped more money into the program, adding \$100 million to the \$282 million previously budgeted for the coming fiscal year 2010. But the administration was under increasing pressure from Congress to make management changes in the program as well. A Senate Appropriations Committee report on the program declared that “the administration needs to disengage from its autopilot management style” and “start making responsible decisions.”

David Powner, GAO’s director of informational technology management issues, elaborated on his agency’s report in testimony before the House Science and Technology Committee’s subcommittee on investigations and oversight in June. “If any planned satellites fail on launch or in orbit,” he said, “there would be a gap in satellite data until the next NPOESS satellite is launched and operational—a gap that could last for three to five years.”

The worst could well happen. Some officials seem ready to give up on NPOESS in its present form. Such pessimism is reflected in

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the recent report of the independent review team (IRT) that the NPOESS executive committee appointed to examine the program in the wake of its restructuring.

A. Thomas Young, a former NASA and Lockheed Martin executive who headed the IRT, told the House subcommittee that NPOESS “has an extraordinarily low probability of success.” Young declared that the program is “hardware poor with little protection against a launch failure or an early spacecraft failure,” and that the continuity of [meteorological] data from space “is at significant risk.”

Even so, the review team recommended

retaining the Northrop Grumman/Raytheon contractor team while making other changes mostly pertaining to its management structure and approaches.

Program origins

The NPOESS program had its beginnings in 1994, when then-President Clinton issued a directive combining the acquisition and operation of military and civilian weather satellites in one integrated program office to be staffed by officials from NOAA, NASA, and the DOD and situated within NOAA.

This consolidation marked a major change from the long-established way of doing business, in which the Air Force and the NOAA/NASA partnership each designed, acquired, and operated its particular weather satellite system in low Earth orbits—the Defense Meteorological Support Program (DMSP) and the Polar Orbiting Environmental Satellite (POES), respectively. Big savings—multibillions of dollars—and much smoother, more efficient management and operations were expected of the move.

NPOESS got under way shortly thereafter, with Northrop Grumman under contract as the system integrator and Raytheon as the developer of prime sensors. In 1998, operational responsibility for DMSP satellites was transferred from the Air Force to the tri-agency Integrated Program Office. Command, control, and communications of both the DMSP and POES systems were combined in NOAA’s Satellite Operations Control Center.

POES and DMSP satellites circle the Earth in near-polar, Sun-synchronous low Earth orbits, monitoring the weather almost continuously. NOAA also operates the geostationary operational environmental satellites (GOES), which are developed, acquired, and launched by NASA, and utilizes data from the European Meteorological Operational (MetOp) satellite as well.

Too many cooks?

There is general agreement that much of the problem with NPOESS lies in its unwieldy, three-headed management structure, in which the administrators of NOAA and NASA and the undersecretary of defense for acquisition make up the NPOESS executive committee. All three agencies are represented in the NPOESS integrated program office, which has management responsibility for the system as a whole and for all weather satellite operations.

The Air Force is in charge of NPOESS acquisition. NASA is responsible for facilitat-

ing the development of new technologies and incorporating them into the system. NOAA and DOD share in the overall funding of NPOESS, while NASA funds specific technology projects and studies under the supervision of the executive committee.

At the House hearing, Mary Glackin, NOAA's deputy undersecretary for oceans and atmosphere, played up both the importance and the plight of NPOESS. She called it a "pivotal constellation" and declared that it is now "at risk."

If the delivery of NPOESS satellites were delayed, or if a catastrophic failure occurred during launch or in space, "NOAA's forecasting ability would be severely degraded, because current forecast models rely heavily on [POES] satellites that will be coming to the end of their useful lives," she asserted.

Glackin said a gap in satellite coverage of six months or more would be "unacceptable for weather forecasting, since NOAA would be unable to produce useful four- and five-day hurricane track forecasts," and that the quality of weather forecast models would degrade.

"A gap in satellite coverage of any length would most likely interrupt critical climate measurements that are needed for the nation to determine the cause, magnitude, and direction of future climate change," she noted.

In an attempt to close the threatened coverage gap, the program executive committee decided to press into service the NPP satellite, now in development, that was originally designed to serve solely as a demonstration satellite lacking some operational attributes.

Program officials were expected to propose a new cost and schedule baseline by the end of June, but were forced to acknowledge near the deadline that critical decisions on constraining costs, tightening the schedule, and mitigating technical risks would have to be put off for perhaps another year.

Funding and other problems

The NPOESS management problems were underscored and thrashed out during the House hearings. Rep. Paul Broun of Georgia, the subcommittee's ranking Republican, noted that the "differing priorities and levels of commitment" of the triagency NPOESS management is to be expected, "given their unique missions."

But, declared Broun, "this divergence has ultimately created an untenable partnership. NOAA is pressured by the scientific community to continue operation of research satellites that feed cutting-edge data into weather

and climate models, while DOD is content to operate legacy [DMSP] hardware. NOAA doesn't have any extra POES satellites to buffer its transition [to NPOESS] while DOD still has two DMSP satellites on the ground. NPOESS is NOAA's flagship mission, yet [it] barely amounts to a rounding error in the Pentagon's budget."

Broun also noted that another reason for NPOESS problems "is simply that space acquisition isn't easy....We aren't asking these agencies to build cardboard boxes....In the end, we are building one-of-a-kind innovative hardware and launching it at 17,500 mph into the vacuum of space."

NPOESS is an example of "putting all our eggs in one basket," Broun said. "We have sought to limit our costs by putting numerous sensors on fewer spacecraft and launch vehicles," thereby limiting opportunities for sequential upgrades. "We have developed an architecture [in which] it seems that failure is not an option."

Contributing to NPOESS problems, the congressman added, are "issues of requirements creep in satellite sensors, schedule pressure in the face of satellite data disruption, and cost caps" from external factors. "It really isn't surprising that the program isn't run well when the managers can't fine-tune fundamental...parameters like cost, schedule, and performance," he declared.

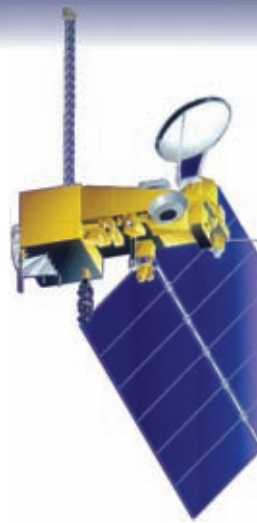


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"Every American is impacted by this program whether they know it or not," Broun said. "It is our responsibility to ensure that the farmers, fishermen, warfighters, and everyday commuters continue to receive weather and climate information."

Review team findings

IRT chairman Young told the House subcommittee that implementing the NPOESS program is "extremely difficult" because the program "is not part of a space acquisition organization." His review team recommended putting NOAA wholly in charge of the program, "with NASA acting as NOAA's acquisition organization." The panel "recognized that NOAA has a broader responsibility for



The White House will be required to define the NPOESS program that is in the national interest."

— A. Thomas Young, IRT chairman

weather and climate requirements than any other organization, and is a natural national advocate for this program," Young said.

The review panel also noted, however, that the Air Force Space and Missile Systems Center would be capable of overseeing NPOESS acquisition.

In the NPOESS program, "the critical issue is that DOD/Air Force and NOAA priorities are not aligned," Young asserted. The IRT found that the Air Force is satisfied with the performance of its existing weather satellites and is unwilling to provide additional funding for the next-generation NPOESS satellites to improve on their performance, he said. NOAA, on the other hand, believes that "accepting legacy [weather satellite] capabilities would be a significant step back."

"This difference in priorities must be resolved," Young added. The panel concluded that the NPOESS executive committee will be unable to resolve it, and that "the White House will be required to define the NPOESS program that is in the national interest."

"Implementation of the IRT recommendations and additional actions is urgently required. Risk and unnecessary cost are being realized at an unacceptable rate," the review panel chairman declared.

The IRT found that the NPOESS managerial agency must have total and absolute acquisition authority, and must be fully responsible for the program's budget and funding, Young told the subcommittee. As things stand, the NPOESS executive committee "is ineffective," he said, because its individual members lack decision-making authority. The triagency NPOESS management considers

cost a more important parameter than mission success in making program decisions, and does not focus on top-level issues and timeliness in the process, said Young.

GAO chimes in

The GAO came down just as hard on NPOESS management. The agency reported that even though the program executive committee has made some improvements over the past several years, "it has not effectively fulfilled its responsibilities" and lacks the membership and leadership to oversee and operate the program.

In that vein, Powner testified last June that the undersecretary of defense for acquisition, technology, and logistics, who represents DOD on the NPOESS executive committee, had never attended the executive committee meetings, and had delegated that responsibility to the undersecretary of the Air Force, who lacks the authority to make acquisition decisions for NPOESS.

As a result, "none of the individuals who attend the...meetings for the three agencies has the authority to approve the acquisition program baseline or major changes to the baseline," and as a result, "agreements between committee members have been overturned by the [Air Force] acquisition authority, leading to significant delays," he noted.

Moreover, he continued, the committee "does not aggressively manage risks, and many of the committee's decisions do not achieve desired outcomes." GAO agrees with the NPOESS review panel that unless and until NPOESS management shortcomings are corrected, "important issues involving cost growth, schedule delays, and satellite continuity will likely remain unresolved."

The GAO report on NPOESS recommends that the secretary of defense direct the undersecretary of defense for acquisition, technology, and logistics to attend and participate personally in NPOESS executive committee meetings. It also recommends that the defense and commerce secretaries and the NASA administrator "establish a realistic time frame for revising the program's cost and schedule baselines," develop plans to cut the risk of gaps in the continuity of weather satellites, and closely monitor the program's progress and effectiveness on all fronts.

Reactions and prospects

NASA and NOAA agreed with all GAO findings and recommendations and said they were taking corrective measures, but DOD's reac-

Problems in the development of the VIIRS (shown) and the cross-track infrared sounder continue to drive up costs.



tion was mixed. The department agreed only to “evaluate” the recommendation that its top civilian acquisition official regularly attend NPOESS managerial meetings.

The news for NPOESS is not all bad. GAO reported that the program has made some progress over the past year: Three of the NPP satellite’s five instruments were delivered and integrated aboard the spacecraft; the ground-based NPP satellite data processing system was installed and tested; and the NPP command, control, and communications systems passed their acceptance testing.

Even so, problems in the development of two critical sensors—the VIIRS and the cross-track infrared sounder (CrIS)—continue to drive up the program’s cost and stretch its schedule, GAO concluded. In addressing these issues, the NPOESS program office halted or delayed activities on other components, including the development of a sensor planned for the first NPOESS satellite, called C1, and redirected its funding to fixing VIIRS and CrIS, GAO said. This caused the costs of those other components to rise, the agency said.

As a result of cost and schedule problems, launch of the NPP satellite has been put off until January 2011, a year later than estimated after the program was restructured in 2006, and seven months later than the July 2010 launch date that was projected a year ago. Moreover, launches of the first and second NPOESS satellites—C1 and C2—are now expected to be delayed at least until March 2014 and May 2016, respectively, GAO reported.



Despite the NPOESS program’s many problems, the capabilities it promises are widely regarded as too compelling to dismiss. The administration’s big boost of funding for the program last summer is seen as a show of faith that it can be, and that it must be, turned around. Many questions remain as to when the NPOESS satellites will finally fly, which instruments will be aboard, or what they will cost, but there is no doubt about their importance to the national interest or the increasingly urgent need for them, officials agree. ▲



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