

U.S. DEPARTMENT OF COMMERCE
Office of Inspector General



**NATIONAL OCEANIC AND
ATMOSPHERIC ADMINISTRATION**

***Acquisition of NEXRAD Transition Power
Source Marred by Management, Technical,
and Contractual Problems***

Final Inspection Report No. OSE-15676/September 2003

PUBLIC RELEASE

Office of Systems Evaluation

TABLE OF CONTENTS

EXECUTIVE SUMMARY	i
INTRODUCTION	1
OBJECTIVES, SCOPE, AND METHODOLOGY	5
FINDINGS AND RECOMMENDATIONS.....	6
I. The Original Decision to Use Rotary TPS Technology Was Well Supported, But the Model Acquired Was Immature and Unproven.....	6
A. Preference for Rotary TPS Was Supported by Analysis and Testing	6
B. The Rotary TPS Acquired Was Not A Proven Product and Experienced Many Problems.....	7
II. The Rotary TPS Was Abandoned Without Sufficient Evaluation.....	10
A. The Prime Offered NOAA the Static TPS as the Subcontractor Attempted to Solve the Rotary Problems	10
B. The TPS Acquisition Shifted Emphasis from Rotary to Static TPS	13
III. The Prime’s Static TPS May Not Be the Most Appropriate Choice for NEXRAD	20
IV. Unclear Accountability, Inadequate Information and Communication, and Insufficient Management Oversight Hampered Decision Making.....	28
V. NOAA Did Not Receive “Best Value” Due to Poor Contract Negotiations and Lack of Oversight.....	31
A. NOAA Paid for Defective TPS Units.....	32
B. Contracting Personnel Did Not Receive Appropriate Review and Oversight	34
C. Price Analysis of Proposals Was Inadequate	36
D. Details of the Settlement Negotiation Are Unclear.....	36
E. NOAA Failed to Adequately Address Prime Contractor’s Contention That the Specification Was Impossible to Perform.....	38
VI. Reviews of Specifications and Other Technical Information Must Be Improved.....	42
VII. Purchase of the Engine Generators Was Outside the Scope of the Contract.....	45
VIII. Conclusion.....	47
Appendix A. Acronyms.....	A-1
Appendix B. NOAA’s Response.....	B-1

EXECUTIVE SUMMARY

In 1992, NOAA's National Weather Service (NWS) began exploring technical solutions to power supply problems affecting the 158 Next Generation Weather Radar (NEXRAD) systems—high resolution Doppler weather radar systems jointly designed, acquired, and operated by the Departments of Commerce (NWS), Defense (Air Force and Navy), and Transportation (Federal Aviation Administration). A tri-agency Radar Operations Center (ROC) located in Norman, Oklahoma, is responsible for meteorological, software, maintenance, and engineering support for all NEXRAD systems. The ROC is a component of NWS' Office of Operational Systems (OOS).

The search for supplementary power sources was prompted by two problems that degraded NEXRAD operability: power loss—and resultant loss of critical data—during transitions between commercial power and the standby engine generator; and poor power quality at remote NEXRAD sites, which shortens the life of the systems' electronics and increases maintenance costs. To solve these problems, the ROC sought to acquire transition power sources (TPS)—uninterruptible power systems that prevent power loss to the radar during power transfer and protect the electronics from commercial power anomalies.

The ROC assessed two TPS technologies: static and rotary. A static TPS consists of a rectifier/battery charger, battery, and inverter; rotary units consist of an electric motor mechanically connected to a generator. In 1993, having concluded that static technology was less suitable due to technical, cost, and environmental issues, the ROC acquired a rotary TPS for testing. The testing showed commercial-off-the-shelf (COTS) rotary technology to be feasible, and NWS decided to acquire rotary TPS units for NEXRAD. The TPS is the major component acquired under the Transition Power Maintenance Shelter (TPMS) contract, which for most sites also includes a shelter to house the TPS, an electric toilet unit, a maintenance workbench, and storage areas.

The Maintenance, Logistics, and Acquisition Division of OOS managed the TPS acquisition in the preaward phase, including preparation of most acquisition documentation. As the technical experts on the TPS, ROC engineers prepared the TPS specification, which the Maintenance, Logistics, and Acquisition Division incorporated into the solicitation. NOAA's Acquisition and Grants Office (NOAA Acquisition)¹ provided the contracting support.

Two companies bid to become the prime contractor (referred to in this report as *the prime*). Both offered to subcontract for the same rotary TPS—a model that was in development at the time by the manufacturer that had provided the commercially available unit tested by the ROC. The contract was awarded on September 27, 1997. The chosen prime was also a manufacturer of static TPS units. Development of the new model rotary TPS was subsequently completed about a year later, and the first unit was accepted by NWS on April 28, 1998.

The ROC reported that when the new rotary TPS units were functioning well, radar component failures and maintenance costs were significantly reduced at sites with poor power—on average

¹ In this report, *NOAA Acquisition* means NOAA's Acquisition and Grants Office; when *NOAA* is referred to by itself, it means both NOAA Acquisition and NWS.

by some \$2,300 per site per month. However, problems were experienced on some units soon after they were installed, and problems continued as installation progressed. Most serious were bearing noise and failures. Although the subcontractor attempted to solve each problem, some were resistant to a solution, particularly the bearing problem. By May 2000, with 94 rotary TPS units installed, 33 were out of service—20 because of bearing problems, including 8 catastrophic failures (i.e., failures that result in total destruction of the motor). On May 9, 2000, the ROC directed that the TPS units be shut down immediately to avoid any further catastrophic bearing failures. This directive came at the recommendation of the subcontractor, who intended to provide an interim solution to avoid such failures until permanent corrections were implemented. The rotary units were never reactivated, however, and contract modification 0022, which authorized acquisition of the prime's static TPS in place of the rotary units, was executed on November 29, 2000.

The decision to switch to the prime's static TPS was made without closely monitoring the subcontractor's progress in implementing corrections and without assessing static units from other manufacturers. NOAA also did not consult with its partner agency—the FAA—regarding that agency's positive experience with (1) rotary units supplied by the same subcontractor for its NEXRAD systems and (2) static units deployed on a similar FAA radar system that incorporated newer technology, which might be more suitable for NEXRAD than the static units provided by the prime.

Events surrounding the contract and the propriety of the modification prompted a letter to the Inspector General dated August 16, 2002, from then-Representative Constance A. Morella, and a follow-up letter from Representative Chris Van Hollen, to the Secretary of Commerce, dated April 28, 2003, which asked the following questions:

- Did the National Weather Service pay for defective equipment (i.e., the original TPS units)?
- Did the actions of the NOAA contracting officer with regard to the contract modification that changed to a different TPS (contract modification 0022) receive proper review and oversight?

We sought to answer these questions, as well as determine whether (1) program and contracting decisions regarding the TPS were reasonable and supportable, (2) the acquisition was planned and managed effectively, and (3) goods and services were delivered as intended.

In answer to the Congressional questions, we found that NWS did indeed pay for defective equipment, and that contract modification 0022 was executed without adequate negotiation and without proper review and oversight by NOAA Acquisition. The result was an estimated increase in contract costs of \$4.5 million. We also found that once the rotary units began to fail, NOAA seriously mishandled the acquisition/management process, with the result that the rotary TPS was abandoned without sufficient evaluation and the prime's static TPS was selected without serious consideration of any other alternatives.

Our detailed findings are summarized below.

- **The Original Decision to Acquire a Rotary TPS Was Well Supported, But the Model Acquired Was Immature and Unproven.**

Before recommending the rotary TPS acquisition, the ROC performed an engineering assessment of both rotary and static technologies and concluded that rotary technology was more suitable for NEXRAD applications: rotary technology did not raise the technical and environmental issues associated with static units,² and was expected to be less costly. The ROC conducted market analysis to identify a rotary unit for testing—selecting a unit that was being used successfully in an operational demonstration of FAA’s Terminal Doppler Weather Radar (TDWR) system, which is similar to NEXRAD. The testing showed that a rotary TPS could satisfy the goal of acquiring COTS equipment and thereby keep costs within set limits and minimize technical and schedule risks.

However, the rotary TPS acquired was a new model, with substantial differences from the commercial model tested at the ROC. Without a commercial track record, the fielded units were essentially being tested in actual operating situations, and weaknesses that might otherwise have been exposed and corrected beforehand were causing major equipment breakdowns at NEXRAD sites. OOS officials told us that they purchased the new units because the older model did not meet requirements for power rating and step load response.³ However, neither the TPS specification nor the results of the ROC’s testing support this contention. NOAA must ensure that in future NWS acquisitions, the items actually selected and contracted for have been thoroughly evaluated and determined to have the capability to meet all critical requirements within acceptable levels of cost, schedule, and technical risk. (See page 6.)

- **The Rotary TPS Was Abandoned Without Sufficient Evaluation**

During the initial stages of the contract, all parties—NOAA, the prime, and the subcontractor—were committed to solving the rotary TPS problems, but the lack of progress, particularly in solving the bearing problem, left NOAA personnel frustrated and the program behind schedule. The first two catastrophic bearing failures occurred in October 1999. In December, the subcontractor provided the prime with a set of corrective actions, but a day after receiving this information, the prime was notified that NOAA would withhold more than \$500,000 in payments due because the rotary TPS units did not meet specifications. The prime ultimately responded with a draft proposal to complete the contract with its own static TPS units.

Meanwhile, catastrophic bearing failures continued. A consultant hired by the prime to assess the bearing failures identified the causes and recommended corrective actions, which included equipping the rotary TPS units with a bearing relubrication system. Although the subcontractor worked to develop and implement corrective actions, the prime’s support for the subcontractor’s efforts waned. In a May 4, 2000, letter to NOAA Acquisition, the prime stated that in two

² These issues were the compatibility of static technology with the NEXRAD engine generator and the environmental hazards of battery disposal.

³ Step load response refers to TPS’ ability to maintain a constant output voltage when sudden load (current) changes occur.

areas—step load response and bearing relubrication—the contract’s TPS specification may be impossible or commercially impractical to meet, and in other discussions referred to the subcontractor’s corrective actions as “band-aid fixes.” Lacking confidence in the subcontractor’s proposed solutions—including a no-cost interim solution to allow the rotaries to operate while protecting them from catastrophic bearing failures until a permanent solution could be developed—NWS had the rotary units permanently shut down. NOAA Acquisition requested an alternate action plan for a static TPS and ordered two of the prime’s static units for testing. Without ever evaluating static units from other manufacturers, NOAA then modified the contract to acquire those of the prime.

Based on our analysis, we conclude that it was in the prime’s interest to sell its own TPS to NOAA, and it was convenient for NOAA to purchase the prime’s static TPS using the TPMS contract rather than seek other alternatives. If it were not for these factors, the prime and NOAA would have had a greater incentive to closely monitor the subcontractor’s implementation of the corrections to the rotary TPS. They also would have had a greater incentive to evaluate other static units in addition to that of the prime. If they had taken these actions and NOAA had still chosen to acquire the prime’s static TPS, its decision would have been more supportable. (See page 10.)

- **The Prime’s Static TPS May Not Be the Most Appropriate Choice for NEXRAD**

Concern about the compatibility of the static TPS with the engine generator was a key reason for the ROC initially selecting rotary technology for NEXRAD. More recently, newer static technology, which solves the engine generator compatibility problem, has become commercially feasible. However, the static TPS purchased by NOAA does not use the newer technology and may be less suitable for NEXRAD than are other units on the market. It also appears to be significantly less reliable.

Engine generator compatibility. Static technology available in the early 1990s, when the ROC performed its engineering assessment, produced high levels of harmonic currents or harmonic distortion, which could be reflected back to the engine generator. Harmonic distortion can overheat conductors and motor windings, reduce the engine generator’s efficiency and service life, and damage other system components such as variable speed motors and air conditioner controls. Total harmonic distortion (THD) is the measure used to define the effect of harmonic distortion on power system voltage or current. To offset potential problems, systems using static TPS units often have oversized engine generators. But this approach was not an option for NWS when it switched to the prime’s static units, because the TPS technology acquired had to be compatible with NEXRAD’s existing engine generators. In testing, the prime’s unit produced reflected current THD at levels well above the 5 percent maximum that was originally established for NEXRAD, in accordance with standards of the Institute of Electrical and Electronics Engineers.

The newer static technology—which was commercially feasible when NWS tested the prime’s units—reduces reflected THD to benign levels, virtually eliminating engine generator incompatibility problems. However, NWS did not evaluate models using the newer technology. Instead, it relaxed the requirement for reflected current THD from a maximum of 5 percent to an average of 20 percent in contract modification 0022. The prime’s unit was thus able to meet the

revised specification, but the long-term effects of reflected harmonic distortion on component service life are uncertain.

Reliability. FAA's experience on TDWR would have been a valuable source of information for NOAA in selecting a static TPS to replace the rotary. In 1998 and 1999, FAA had deployed 45 of the newer technology static TPS units to support its TDWR systems. A comparison of the reliability of the FAA and NWS units shows significantly higher reliability for the former: mean time between failure of over 800,000 hours for FAA's units as compared to less than 80,000 for those of NWS. Because NOAA did not assess the FAA's experience, its evaluation and decision-making process was incomplete and pertinent information was not taken into account. In future NWS acquisitions, NOAA must identify, thoroughly analyze, and document all reasonable alternatives. (See page 20)

- **Unclear Accountability, Inadequate Information, and Insufficient Management Oversight Hampered Decision Making**

Two geographically separated organizations within OOS were involved in the TPMS acquisition, the Maintenance, Logistics, and Acquisition Division at NWS headquarters in Silver Spring, Maryland, and the ROC in Norman, Oklahoma. In the preaward phase, the program manager and contracting officer's technical representative (COTR) were located at OOS headquarters. After contract award, COTR responsibility was officially transferred to the ROC, but program management responsibility was not addressed and thus became unclear. As a result, there was a lack of leadership and accountability on the TPS acquisition. No one was clearly assigned responsibility for ensuring that management and technical decisions were well supported or that senior NWS officials were given complete and accurate information to enable effective oversight. This circumstance led to poor decision making and negotiations on modification 0022.

To correct these deficiencies in future acquisitions of complex items for NEXRAD and other systems, NWS must ensure that management and technical responsibilities are clear and are assigned to personnel with appropriate acquisition and technical experience and expertise; activities, information, and decisions are effectively coordinated among and communicated to all concerned parties; and COTRs and program managers understand their individual responsibilities for achieving contract and program goals and keeping supervisors and senior agency officials fully informed of all relevant contract-related information. (See page 28.)

- **NWS Did Not Receive "Best Value" Due to Poor Contract Negotiations and Lack of Oversight**

As problems with the rotary TPS continued, most significantly the catastrophic bearing failures, NOAA began considering the options for addressing contract performance problems. It began to withhold payments and issued cure notices in April and July of 2000. The cure notices cited the prime's failure to comply with the specifications in the contract, and requested an action plan to correct the defective rotary TPS units. In response to the second cure notice, the prime asserted that the specification was impossible to perform. NOAA considered alternatives to ensure the continuity of the program, including termination of the contract for default, acceptance of the prime's impossibility argument and all costs, and negotiating a settlement.

Ultimately, the decision to acquire the static TPS was formalized in contract modification 0022, which established a new specification for the static TPS units and provided for replacement of the 94 rotary units already installed; pricing for the 58 new TPMS sites; revised maintenance pricing based on the new specifications; and revised data, training, and spares requirements. At the time the modification was executed, NOAA had paid \$3.8 million for equipment and associated costs, and was withholding payments and fees of \$996,499. In negotiating the switch to its static units, the prime initially proposed the retrofit of the 94 rotary units at a cost of \$4.2 million and installation of 56 new static units at a cost of \$5.3 million. The proposal noted that this amount reflected \$2.6 million in credits and discounts, conditional upon NOAA's paying the withheld payments and fees.

Several weeks later, the prime contractor submitted a revised proposal in which it agreed to waive the outstanding payments but reduced the discount originally offered. According to the proposal, NOAA had agreed to the reduced discount in return for the waiver. This reduction resulted in an increase in the total proposed price in the amount of \$996,499, the exact amount of the payments that had been withheld. NOAA accepted this proposal without adequate analysis and negotiation, and in so doing, paid for all defective or removed rotary units. As a result of modification 0022, total contract costs were increased by an estimated \$4.5 million, as shown in the table below. The estimated cost for the retrofit of the completed sites (with the rotary TPS) increased the contract amount by \$5,204,025. Savings were realized primarily as a result of the price of the static TPS units being less than that of the rotary for the new installations. We estimate these savings to be \$726,723.⁴

Cost Impact to Original Contract

Prime's Final Proposed Cost for Retrofit of Sites Having Rotary Units	\$5,204,025
Less Estimated Savings Attributed to New TPMS Installations	(726,723)
Total Estimated Additional Cost To NOAA	\$4,477,302

We found that the contracting officer responsible for the TPS acquisition did not adequately review preaward and postaward contract documentation, ensure that a proper price analysis was conducted, or exercise appropriate oversight for the issuance of modification 0022. The Federal Acquisition Regulation (FAR) states that the contracting officer is responsible for evaluating the

⁴ Our estimate is based on the difference between the estimated cost delineated in the basic contract for the remaining new installations using a rotary TPS and the estimated cost for new installations with the static TPS in modification 0022. This estimate does not include maintenance, spares, or extended warranties.

reasonableness of proposed prices. Without adequate analysis, the contracting officer cannot establish a strong negotiating position or know whether proposed prices are fair and reasonable.

NOAA's ultimate acceptance of the prime's argument that the specifications were impossible to perform weakened its negotiation position. The prime contractor supported its assertions by citing a Navy study on bearing lubricants. We found the results of this study unpersuasive with regard to the TPS because, among other things, it involved different bearings, lubricants, and operating conditions. Moreover, before contract award, the subcontractor had demonstrated that its technology could satisfy the reliability requirement.

NOAA must ensure that quality review procedures for significant procurement actions are established and implemented, clearly identifying roles and responsibilities, and assuring appropriate oversight and accountability; that contracting personnel receive appropriate training in cost and price analysis and negotiation techniques; and that contracting officers are briefed by technical personnel regarding all technical issues that may arise in contract negotiations. (See page 31.)

- **Reviews of Specifications and Other Technical Information Must Be Improved**

Our analysis found that several TPS requirements that may not have been needed contributed to the technical and contractual issues surrounding the bearings. The consultant hired by the prime to assess the bearing failures concluded that the fundamental cause was insufficient bearing lubrication and excessive vibration. The FAR stipulates that in conducting acquisitions, agencies' needs should be stated as performance requirements rather than design requirements whenever feasible. The TPS specification required sealed, permanently lubricated bearings—a design element aimed at minimizing bearing maintenance. Other requirements—that preventive maintenance not exceed 1 hour per year and system reliability meet a mean time between failure of 5 years—were performance elements that would have achieved the same end. But because the design feature was prescribed, the specification had to be changed in order to allow the subcontractor to implement the proposed relubrication system, and because such a change was required, the prime was able to argue that the specification was impossible to meet.

The original specification also prescribed a weight limit for the TPS, which prompted the subcontractor to substitute an aluminum version of a ductile iron component used in its commercial TPS unit, and the substitution resulted in excessive vibration. However, the specifications do not support the need for a weight requirement, nor was this requirement validated after NWS learned of the substitution. Since the subcontractor used aluminum to satisfy the TPS specification and retrofitting the units with ductile iron required a specification change to eliminate or increase the weight limit, the prime was able to charge the government for the retrofit.

Because specifications become legal requirements when they are incorporated into contracts, all requirements must be necessary and expressed in a way that will allow them to withstand contractual and legal challenges. Thus, it is essential that technical, contractual, and legal personnel provide an integrated review of specifications and statements of work that comprehensively address all technical, contractual, and legal concerns before a solicitation is issued, particularly for the acquisition of complex items. Well coordinated reviews are also

needed after contract award. NOAA must ensure that in future acquisitions, government needs are stated as performance requirements whenever feasible and that specifications receive integrated technical, contractual, and legal review. (See page 42.)

- **Purchase of Engine Generators Was Outside the Scope of the Contract**

In 2001, the TPMS contract was modified twice to allow acquisition of seven new engine generators at various NEXRAD sites. According to NWS personnel, the upgraded generators were needed to handle additional power loads. The TPMS contract, however, was not the appropriate vehicle for purchasing engine generators.

Under government contract law, work lies within the scope of a contract if it was reasonably contemplated by the parties when the contract was entered into. Replacement of the engine generators was not the intent of the contract, and various documentation from NWS, and the prime contractor makes clear that they were fully aware of this fact. In future NWS acquisitions, NOAA must ensure that there is adequate review and oversight of proposed modifications to verify and document that they fall within the scope of the contract being modified. (See page 45.)

- **Conclusion**

We found that NOAA mishandled the process of addressing the management, technical, and contractual problems on the TPS acquisition. Unclear accountability and inadequate oversight were significant contributors to these problems. To prevent these types of problems from occurring on future acquisitions, NWS and NOAA Acquisition need to perform their own evaluations to determine any additional factors that may have caused the problems on the TPS acquisition and identify improvements that are required in policies, procedures, and oversight. They also need to determine whether any personnel involved in the TPS acquisition require additional training or closer supervision. (See page 47.)

In its response to our draft report, NOAA agreed with our recommendations, stating they represent good business practice, while at the same time disagreeing with most of our specific findings. NOAA provided no comments on our finding on unclear accountability, indicating neither agreement nor disagreement. NOAA described the decision of whether to continue with the rotary unit as a tough judgment call for its managers. Indeed it was. And that is why NOAA managers shortchanged themselves by failing to ensure their staffs provided accurate information and sound analysis for making their difficult judgments. Of particular concern is the fact that, while acknowledging many important business practices were ignored on this complex acquisition, NOAA's response attempts to defend virtually all of its actions and their outcomes. We urge NOAA Acquisition and NWS to give particular attention to our recommendation to evaluate their acquisition policies, procedures, and oversight to identify actions needed to prevent similar problems from occurring on other acquisitions.

Where appropriate, we have modified the report based on NOAA's comments. Most significantly, NOAA's response correctly pointed out that the first two rotary units purchased by FAA did not have the permanent corrections (relubrication system and firmware) when they were tested in the factory in June 2000, a fact FAA personnel recently clarified. FAA believed the relubrication system was not needed because its TPS was based on the subcontractor's commercial design, which did not have such a system. (The relubrication system was later installed on the subcontractor's commercial units and FAA units.) FAA's first two units had the permanent firmware corrections when they were delivered in November 2000.

NOAA responded to our draft report as if we had argued that the decision on continuing with the rotary TPS should have been delayed until FAA's units were accepted and proven with the permanent corrections installed. That is not the case. Rather, we state that NWS should have been monitoring FAA's progress in acquiring its rotary units, a position that is not changed by the fact that the initial units tested in the factory did not contain the permanent corrections. Our report indicates that the first two FAA units were delivered in November 2000 but were not accepted until March and June 2001. NOAA's response incorrectly implies that FAA's delay in accepting the first two units was related to its not having the corrections. It also presents incorrect information about bearing issues on FAA's units, which we address on page 18.

One of NOAA's principal rationales for its decision to abandon the rotary and adopt the prime's static TPS is that the prime's unit was the quickest solution for obtaining the benefits of a reliable TPS. NOAA also stated that it did not allow the subcontractor's interim fixes to be implemented because they failed to perform. Our report acknowledges that the interim corrections needed refinement, but they were certainly worth pursuing. If successful, the interim corrections would have permitted 94 NEXRAD radars to operate with TPS protection, mitigating the pressure to reach a decision quickly and allowing NOAA to take the time to make a more informed judgment. NOAA's position that haste was needed is not an acceptable reason for failing to exercise responsible program and contract management, and, in any case, NOAA's position is questionable. The ROC's own reliability data shows it takes an average of 10 days for a failed static TPS unit to be repaired and placed back on-line protecting the NEXRAD radar. A delay of this duration would not typically be tolerated for a critical system component.

In defending its choice of the prime's static unit, NOAA stated that the technology met reliability and performance specifications, and after 1.9 million hours of operation through June 30, 2003, no negative effects were observed. However, as our report points out, the unit only meets the specification because it was relaxed to accommodate the high levels of reflected harmonic distortion, and problems caused by harmonic distortion may develop over the long-term and thus not yet be apparent. And a problem recently has been experienced at one site that NEXRAD technicians believe is caused by reflected harmonic distortion. This site's new air conditioning units intermittently shut down when the load is transferred to the engine generator while the TPS is on-line. The technicians believe that reflected harmonic distortion is triggering the phase monitors (which check the power for abnormal conditions) to shut the air conditioning units down.

As a further rationale for abandoning the rotary and acquiring a static unit, NOAA's response noted that FAA had switched from a rotary TPS to a static unit in its TDWR system. What this response does not note and NWS engineering personnel failed to state in their briefings to senior

management is what finding IV (page 29) points out: the TDWR's static TPS uses the newer technology, which virtually eliminates problems caused by reflected harmonic distortion and is more reliable than the unit acquired by NWS.

A synopsis of NOAA's response and our comments are presented after each finding. NOAA's response is included in its entirety as Appendix B.

INTRODUCTION

According to the Department's procurement executive, almost one-third of Commerce's more than \$5 billion appropriation is spent through contracts and other procurements vehicles. Thus, effective acquisition management is critical to the Department of Commerce. Because of the serious, recurring problems we have identified in our acquisition and contract reviews, we view effective management of the acquisition process as one of the top 10 management challenges facing the Department. Careful acquisition planning, promotion of competition and prudent review of competitive bids, adept contract negotiations, well-structured contracts, and effective contract management are principles we focus on in evaluating the Department's performance in meeting this challenge. Hence, an important element of our *Office of Inspector General Work Plan FY 2002—04* is to conduct reviews and audits of selected acquisition programs, projects, and contracts. As part of this work plan element, we evaluated program and contracting decisions associated with NOAA's National Weather Service (NWS) acquisition of the transition power source (TPS) for the Next Generation Weather Radar (NEXRAD).

NEXRAD is a weather radar system (WSR-88D)⁵ jointly designed, acquired, and operated by the Departments of Commerce (NWS), Defense (Air Force and Navy), and Transportation (Federal Aviation Administration). The 158 operational NEXRAD radar systems deployed throughout the United States and at selected overseas locations provide information to support severe weather and flash flood warnings, air traffic safety and flow control, resource protection at military bases, and management of water, agriculture, forest, and snow removal. A tri-agency Radar Operations Center (ROC)⁶ was established to provide life-cycle support for NEXRAD. Located in Norman, Oklahoma, ROC is a component of NWS' Office of Operational Systems (OOS).

TPS is being acquired⁷ to solve two problems: power loss during transitions between commercial power and the standby engine generator, and poor power quality at remote NEXRAD sites. Valuable meteorological data was lost during power transfers because the radar's processors shut down and restarted slowly. In addition, many NEXRAD systems are located in remote areas with poor commercial power, causing voltage sags, surges, and other anomalies that shorten the life of the system's electronics and increase maintenance costs. TPS is an uninterruptible power system (UPS) that prevents power loss to the radar during power transition and protects the electronics from commercial power anomalies. It is the major component acquired under the Transition Power Maintenance Shelter (TPMS) contract, which for most sites also includes a shelter to house the TPS, an electric toilet unit, a maintenance workbench, and storage units. Some remote sites already have shelters and are receiving only the TPS.

Three years after contract award and the installation of 94 rotary TPS units, a major contract modification was executed to enable NWS to switch to a different TPS technology because of problems with the units. Whereas a subcontractor had manufactured the original TPS units, the contract was modified to procure a TPS manufactured by the prime contractor (referred to in this report as *the prime*).

⁵ WSR-88D stands for Weather Surveillance Radar - 1988 Doppler.

⁶ The Radar Operations Center was formerly called the Operational Support Facility (OSF).

⁷ The acquisition of TPS units is ongoing; startup of the final unit is scheduled for September 24, 2003.

Background

In 1992, the ROC began to investigate technical solutions for a TPS that would meet the stringent requirements of NEXRAD. Two technologies were assessed—static and rotary. A static TPS consists of a rectifier/battery charger, battery, and inverter (figure 1); a rotary TPS consists of an electric motor mechanically connected to a generator (figure 2). In 1993, having concluded that static technology was less suitable due to technical, cost, and environmental issues, the ROC acquired a rotary TPS for testing. The testing showed commercial-off-the-shelf (COTS) rotary technology to be feasible, and the ROC’s test report was used to support the development of acquisition documents for a NEXRAD TPS.

Figure 1: Static TPS

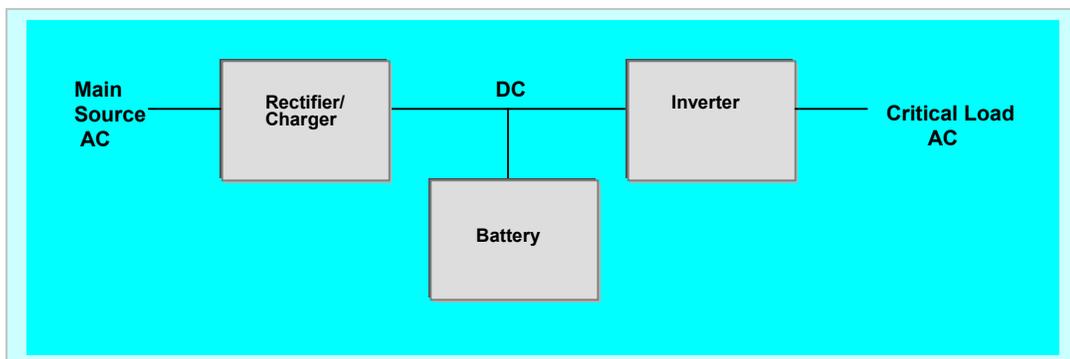
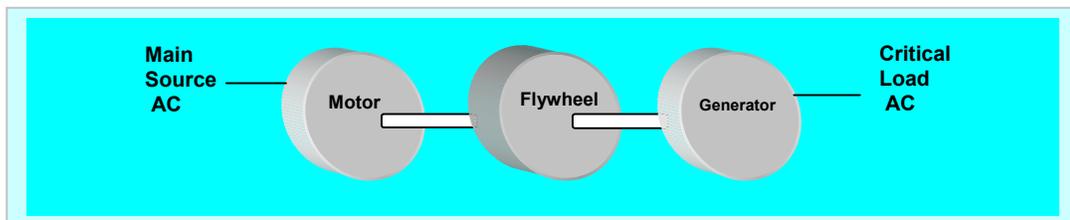


Figure 2: Rotary TPS



The Maintenance, Logistics, and Acquisition Division of OOS is responsible for acquiring equipment for NWS systems and developing standards and guidelines for technical specifications and requests for proposals. This division managed the TPS acquisition in the preaward phase, including preparation of most acquisition documentation. As the technical experts on the TPS, ROC engineers prepared the TPS specification, which the Maintenance, Logistics, and Acquisition Division incorporated into the solicitation. Because the TPS was the most complex component of the acquisition, the contracting officer’s technical representative (COTR) was located at the ROC after contract award to oversee its proper implementation.

NOAA’s Acquisition and Grants Office (NOAA Acquisition)⁸ provided the contracting officers and contracting specialists for this acquisition.

In 1996, notice of the government’s intent to purchase the TPS was published in the *Commerce Business Daily* (CBD). Although NWS did not believe a TPS using batteries was feasible, it wanted to ensure fair and open competition. Thus, the notice stated a preference for motor-driven (rotary) technology but indicated that all technologies would be considered:

A central component to be provided by the contractor is the high daily duty-cycle, long ride-through TPS that uses motor-driven technology compatible with the existing WSR-88D standby diesel generator. In addition to the concern for compatibility between the TPS and the existing generator, the NWS is concerned that necessary environmental conditions for energy storage batteries cannot be ensured and that routine servicing at remote locations cannot be guaranteed during the winter season. Notwithstanding these concerns, offerors are advised that all types of technologies will be considered for contract award.⁹

Two companies bid for the contract. Both offered to subcontract for the same rotary TPS—a new model that was in development at the time—produced by the manufacturer that had provided the commercially available unit previously tested by the ROC. The contract was awarded on September 25, 1997, giving the prime responsibility for the overall design, integration, production, test, site preparation, delivery, installation, and documentation of the TPMS. The TPS subcontractor was responsible for supplying the as-yet unavailable rotary units to the prime. The chosen prime was also a manufacturer of static TPS units. (See box for a description of the various TPSs discussed in this report.) Development of the new model was subsequently completed, and the first unit was accepted by NWS on April 28, 1998.

TPSs Discussed in this Report	
TPS Type	Description
Rotary	<u>Older COTS Model</u>
	• Tested at ROC
	• Installed at FAA NEXRAD sites
	<u>New Model</u>
Static	• NWS NEXRAD version
	• FAA NEXRAD version (replaced older COTS model)
	• COTS version
	Prime contractor’s COTS model
	Competing COTS technology

Widespread problems prompt contract modification

When the rotary TPS units were functioning well, radar component failures and maintenance costs significantly declined. However, as units were installed and operated, the TPS experienced numerous problems at many NEXRAD sites. Most serious were bearing noise and failures. Although the subcontractor attempted to solve each problem, some were resistant to a solution, particularly the bearing problem. By May 2000, with 94 rotary TPS units installed, 20 had experienced bearing problems, including 8 catastrophic failures (i.e., failures that result in total destruction of the motor). The prime had received full payment for 70 of these units and 90 percent payment for 7 additional units. On May 9, 2000, the ROC directed that the rotary TPS units be shut down immediately to avoid any further catastrophic bearing failures. This directive came at the recommendation of the subcontractor, who intended to provide an interim solution to

⁸ In this report, *NOAA Acquisition* means NOAA’s Acquisition and Grants Office; when *NOAA* is referred to by itself, it means both NOAA Acquisition and NWS.

⁹ *Commerce Business Daily*, July 12, 1996.

avoid such failures until permanent corrections were implemented. The rotary TPS units were never reactivated, however, and contract modification 0022, which incorporated the prime's static TPS into the contract, was executed on November 29, 2000.

As a NEXRAD partner, the Federal Aviation Administration (FAA) was originally part of the TPMS contract. However, FAA decided not to use the contract for two reasons. First, the power at FAA NEXRAD sites is particularly poor so a TPS was needed more quickly than the contract would provide. Second, FAA did not need maintenance shelters and thus could save money by procuring TPS units directly from the manufacturer. FAA's NEXRAD product team initially purchased the rotary TPS model that had been tested at the ROC and installed units at all 12 of its NEXRAD sites. After the TPS began operating, it became apparent that because FAA sites operate in a redundant configuration to ensure high availability—with two processors, receivers, and transmitters in the radar data acquisition channel—a larger capacity TPS was needed. The requirement for a larger TPS became especially pronounced after a change was made to the NEXRAD calibration software, which increased power demand. FAA decided to replace its TPS units with a larger version of the same new rotary model that was being purchased under the TPMS contract, and signed a contract for the new model on October 29, 1999.

As FAA was procuring the new rotary TPS, the problems on the TPMS contract were occurring. However, FAA officials told us they had confidence in the subcontractor's ability to solve the TPS problems. FAA chose not to acquire the relubrication system when it purchased the initial new rotary TPS units. The agency believed the system was not needed because its TPS was based on the subcontractor's commercial design, which at the time did not have the system. Although FAA's units did not experience bearing problems, the agency later decided it would be prudent to install the relubrication system, and the subcontractor also installed the system on its commercial units. The first two units delivered to FAA had the permanent firmware corrections.

FAA began operating its first two new rotary TPS units in November 2000,¹⁰ and accepted the twelfth and final unit in April 2003. The headquarters officials responsible for acquiring the TPS units told us that some problems had been experienced but were easily solved. Although the units have not been in operation long enough to conclusively demonstrate their long-term performance and reliability, according to headquarters engineers and management officials responsible for their acquisition and field support, the corrections were effective and the units are performing well.

¹⁰ The first two units, installed in Kenai and Fairbanks, Alaska, were put into operation and conditionally accepted on November 3, 2000. Full acceptance for the Kenai unit occurred on March 19, 2001, and for the Fairbanks unit on June 1, 2001.

OBJECTIVES, SCOPE, AND METHODOLOGY

The purpose of this evaluation was to determine whether (1) program and contracting decisions regarding the TPS were reasonable and supportable, (2) the acquisition was planned and managed effectively, and (3) goods and services were delivered as intended. As part of this review we addressed the following issues raised in a letter dated August 16, 2002, from then-Representative Constance A. Morella to the Inspector General and in a follow-up letter from Representative Chris Van Hollen to the Secretary of Commerce, dated April 28, 2003:

- Did the National Weather Service pay for defective equipment (i.e., the original TPS units)?
- Did the actions of the NOAA contracting officer with regard to the contract modification that changed to a different TPS (contract modification 0022) receive proper review and oversight?

To accomplish our objectives, we reviewed preaward and postaward contract documentation, including documentation and analysis in support of modification 0022; the original and revised versions of the TPS statement of work, technical specifications, test plans, and test reports; correspondence between NOAA and the prime; and correspondence from the rotary TPS subcontractor to the prime. We interviewed the contracting officer and COTR assigned to the program at the time modification 0022 occurred, and other contracts, management, and technical personnel in NOAA Acquisition, NWS headquarters, and the ROC. We also interviewed the attorney in the Office of General Counsel (OGC) who advised NOAA on the TPMS acquisition. In the course of our work we found that some of the COTR's files pertaining to modification 0022 were missing. ROC officials told us that the files were misplaced during their transfer to a new COTR.

Additionally, we interviewed FAA personnel responsible for procuring uninterruptible power systems for that agency's weather radars, as well as FAA power systems experts, and we reviewed pertinent documentation provided by FAA officials. Finally, we interviewed personnel who worked for the prime and personnel who worked for the subcontractor that supplied the rotary TPS. We conducted our fieldwork between November 13, 2002, and April 2, 2003.

This evaluation was performed in accordance with the *Quality Standards for Inspections* issued by the President's Council on Integrity and Efficiency under 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

I. The Original Decision to Use Rotary TPS Technology Was Well Supported, But the Model Acquired Was Immature and Unproven

The original decision to use a rotary instead of a static TPS was well supported, and the availability of a COTS TPS that could satisfy program requirements was demonstrated. However, the particular rotary TPS that was acquired was a new model without a commercial history, and it experienced many problems.

A. Preference for Rotary TPS Was Supported by Analysis and Testing

Before recommending that a rotary TPS be acquired, the ROC performed an engineering assessment, market analysis, and testing between 1992-1994. This work was described in a report transmitted to NWS headquarters in July 1994.¹¹ According to the report, the TPS had to meet the following engineering criteria:

- be able to supply continuous power to critical NEXRAD electronic components during power transitions with no degradation of voltage or frequency;
- be fully compatibility with all NEXRAD performance requirements and electronic circuit functions;
- be environmentally sound; and
- have low maintenance costs and low recurring costs.

The ROC assessed rotary and static technology and consulted with organizations involved in power transition for radars including other government agencies, MIT Lincoln Laboratory, and radar manufacturers and engineers. The assessment raised concerns about the compatibility of a static TPS with NEXRAD equipment, as well as the environmental impacts and cost of battery disposal for static units.¹² In addition, as stated in the CBD announcement, there was a concern about the environmental conditions for static TPS batteries since the equipment would have to withstand a wide range of operating and storage temperatures. The assessment stated that rotary technology appeared to pose none of these problems and had the additional advantage of providing complete electrical isolation of the radar, and concluded that rotary technology should be tested.

The ROC then performed a market study to identify a rotary TPS unit to be tested using information obtained from other government agencies, private research organizations, and industrial manufacturer and vendor listings. The unit selected was being used successfully in

¹¹ WSR-88D Operational Support Facility, July 6, 1994. *A Rotary Uninterruptible Power System (UPS) for Improved Performance and Reliability*. Norman, OK: WSR-88D OSF.

¹² Batteries contain hazardous materials that may enter the environment. For example, lead from batteries can enter soil and water from landfills and enter the air via municipal waste incinerators.

an operational demonstration by MIT Lincoln Laboratory for FAA's Terminal Doppler Weather Radar (TDWR) system, a weather radar similar to NEXRAD.

The goals of the test program were as follows:

- Ascertain compatibility with the NEXRAD radar.
- Determine ease of installation by field technicians.
- Prove ease of operation.
- Assess durability and maintainability.
- Verify the required ride-through time (i.e., the duration that TPS can maintain output voltage and power ratings upon loss of power).

The ROC acquired the rotary TPS—a unit different from the one later acquired under the contract—to perform independent testing with NEXRAD. In order to prove that the unit was truly COTS equipment and could be handled by other than a factory-trained technician, ROC personnel installed and checked out the unit without assistance from the manufacturer. A two-phase test program began in May 1994. In the first phase, specific tests were conducted over a 4-day period including testing of worst-case scenarios. In the second phase, the TPS was operated on-line for 30 days with critical parameters monitored.

The test report concluded that a rotary TPS was a viable solution for the NEXRAD power transition issues and recommended that it be acquired. The test report was transmitted by the ROC to NWS headquarters on July 11, 1994, accompanied by a memorandum stating that the information was intended to support the development of acquisition documents for an uninterruptible power system for NEXRAD. Based on this work, a specification for a rotary TPS was prepared for the acquisition.

B. The Rotary TPS Acquired Was Not A Proven Product and Experienced Many Problems

According to the acquisition plan, the TPMS would use COTS equipment and technology; therefore, the technical, cost, and schedule risks were deemed manageable. The primary objective of acquiring COTS equipment is to capitalize on proven technology in order to reduce the cost, time, and risk of developing a new product. The Federal Acquisition Regulation (FAR) defines a commercial item as any item that is customarily used by the general public or by non-governmental entities for other than governmental purposes and that has been sold or offered for sale to the general public. A commercial item may also be one that has evolved from an existing commercial item through advances in technology or performance, but is not yet available in the commercial marketplace. Such an item must be available in time to satisfy the delivery requirements under a government solicitation.¹³ However, the rotary TPS included in the TPMS contract was a new model, with substantial differences from the subcontractor's commercial model, and it was still being developed and thus was unproven at the time of contract award.

¹³ *Federal Acquisition Regulation*, Subpart 2.101 - Definitions.

The proposed rotary TPS was tested before contract award as part of the contractor selection process. However, the unit tested was the first new model to be built and not all of its new components were fully developed; thus, it was different from what would be delivered under the contract and what would become available commercially. Because this TPS lacked a commercial track record, some requirements in the factory test, such as bearing reliability, were fulfilled, in part, using data about the manufacturer's existing commercial model, even though the new model was different in important respects, including greater size and weight, new electronics aimed at better voltage control, larger bearings, and a lower bearing rotation speed.

As rotary TPS units were installed and operated at NEXRAD sites, they experienced numerous problems, including bearing noise and failures, control card failures, vibration, voltage regulation, and high input current. In May 2000, the ROC directed the rotary TPS units to be shut down to avoid any further catastrophic bearing failures. At that time, 33 of the 94 installed units were out of service—20 for bearing problems, 8 for control failures (e.g., failed drivers, wiring issues, and high vibration), and 5 for other problems.

During our fieldwork, OOS engineers and management officials at headquarters told us that they had viewed the new rotary TPS design as a low-risk upgrade to the older model. They also told us that it was necessary to purchase the new TPS because the older model did not meet the requirements in two areas: (1) power rating, including ability to satisfy the electric power requirements at FAA sites and NWS mountaintop sites, both of which are redundant,¹⁴ and (2) step load response.¹⁵ However, the TPS specification and results of the ROC's testing do not support this position. The TPS specification requires a 35 kVA/28 kW unit, the same power rating as both the rotary TPS tested at the ROC and the new rotary unit that was proposed and acquired. Neither the original TPS specification nor the more recent version, which incorporates revisions to accommodate the static TPS, contains a requirement for higher power at NWS redundant sites. Moreover, the 1994 test report identified no deficiencies in step load response. (As discussed in finding II (page 12), step load response proved to be a problem for the new rotary TPS.)

In our opinion, NWS should have more carefully considered the risk associated with purchasing a new TPS design in view of its intent to enter into a low-risk COTS acquisition. While we understand that only the new model was bid by both offerors, we believe that NWS should have explored the possibility of acquiring the previous model, which had a successful commercial history. If acquiring the new model was still considered preferable, the increased cost, schedule, and technical risks should have been explicitly accounted for in program planning and management.

¹⁴ FAA's redundant configuration operates with power available to most equipment. NWS redundant systems have two radar data acquisition (RDA) channels designed to operate with the second, or nonoperating, RDA channel in a power-off condition.

¹⁵ Step load response refers to TPS' ability to maintain a constant output voltage when sudden load (current) changes occur.

Recommendation

The Assistant Administrator for Weather Services and the Director of NOAA's Acquisitions and Grants Office should ensure in future acquisitions that the items selected and contracted for have been thoroughly evaluated and determined to have the capability to meet all critical requirements within acceptable levels of cost, schedule, and technical risk.

Synopsis of NOAA's Response

NOAA responded that the overall technology of rotary TPS units was proven effective by ROC tests, but the specific model bid was unproven. The response stated that the size of the required TPS unit was not changed from the original 35 kVA requirement and that bidders chose to offer the new unit. NOAA said that ROC engineers anticipated that FAA might need to operate two of the older model units in parallel because of the mode of operation at those sites. The response indicated that motor generator sets are not efficient at high altitudes, meaning that a larger emergency motor generator set—not a larger TPS unit—is required. It contended that FAA's change to a larger motor generator and larger rotary TPS confirms the demands a rotary TPS makes on a motor generator set.

OIG Comments

Like NOAA's response, our report states that rotary TPS technology was proven. That is why we believe NOAA was remiss in accepting the prime's contention that the specification was impossible to perform, as discussed in finding V (pages 38-39). Our report also indicates that only the new model was bid by both offerors and argues that NWS should have explored the possibility of acquiring the previous model, which had a successful commercial history. We stated that if, in fact, acquiring the new model was considered preferable, the increased cost, technical, and schedule risks should have been explicitly accounted for in NOAA's program planning and management.

NOAA's response discussed the rotary TPS and motor generator sets; since the rotary TPS *is* a motor generator and considering the points being made by NOAA in its response, it appears that NOAA is referring to "engine generator" sets and is arguing the need for larger engine generators at high altitudes. This finding, however, does not address engine generators, but rather the justification for purchasing a new rotary TPS for a program that intended to acquire COTS equipment. Engine generators are discussed in finding VII (page 45), where we explain why NOAA's purchase of new generators was outside the scope of the TPMS contract. That finding disputes how the larger engine generators were purchased, not whether they were needed.

II. The Rotary TPS Was Abandoned Without Sufficient Evaluation

The subcontractor worked to correct the problems with the rotary TPS, but its lack of progress, particularly in solving the bearing problem, left NOAA personnel frustrated and the program behind schedule. As the prime began proffering its static TPS and NOAA began to show interest, the prime's support for the rotary waned. In November 2000, NOAA officially abandoned the rotary and adopted the prime's static TPS, without having made a serious attempt to assess other alternatives. As the decision to switch was being made, the rotary subcontractor had come to understand the causes of the problems and was devising more effective corrections. However, NOAA lacked confidence that these corrections would be effective and did not ensure the subcontractor's efforts were adequately monitored. We believe that NOAA abandoned the rotary TPS without sufficiently evaluating the progress being made on the corrections. At the same time, FAA was purchasing rotary TPS units directly from the subcontractor—a larger version of the same TPS model—for use on its own NEXRAD systems.

A. The Prime Offered NOAA the Static TPS as the Subcontractor Attempted to Solve the Rotary Problems

The time line of major program events, which appears on the next page and subsequent pages, traces the series of steps that led to the contract modification. At first, all parties—NOAA, the prime, and the subcontractor—were committed to solving the rotary TPS problems. Discussions were ongoing at program management reviews and technical interchange meetings, as well as in correspondence and other communications between NOAA and the prime and between the prime and subcontractor.

Problems continued, however. In May 1999 NOAA withheld payment for defective units for the first time, and in October 1999, the first two catastrophic bearing failures occurred. On November 9, 1999, the COTR sent a letter of concern to the prime about the bearings, as well as other problems, and a TPS issues meeting was held in early December. Two weeks later, the subcontractor provided a set of corrective actions to the prime, some of which it was still testing and a few that it was ready to implement. The next day, the prime was notified that the government would withhold more than \$500,000 for five TPMS systems because the TPS units did not meet specifications. On December 22, the prime sent a letter to NOAA Acquisition with a proposed action plan, which, in addition to addressing the rotary TPS, stated that a draft value engineering change proposal (VECP)¹⁶ was being prepared with the goal of improving performance, reliability, quality, and life-cycle costs. The proposed change in this VECP was a shift to the prime's static TPS.

¹⁶ A VECP is a proposal designed to reduce the overall projected cost to the agency without impairing essential functions or characteristics. The objective is for the contractor and government to share in the savings.

On January 18, 2000, the NOAA contracting officer sent a second letter of concern addressing the reliability of the rotary TPS, including the catastrophic bearing failures, and requested an action plan. On February 1, the prime responded that it was not yet ready to submit a detailed action plan because proven solutions for all identified problems had not been found. On February 4, the prime submitted a draft VECP for completing the contract with its static TPS in lieu of the subcontractor's rotary TPS.¹⁷

On March 29, after a total of eight catastrophic bearing failures, the subcontractor sent a letter to the prime strongly recommending that the fielded TPS units be shut down until an improved vibration detection system and revised motor controller firmware¹⁸ were installed in order to avoid further bearing failures. The letter stated that these corrections were "Service Required" upgrades

that the subcontractor wanted to install as soon as possible. The prime forwarded the letter to the government the next day, recommending that the units be shut down until all known deficiencies were corrected. (NWS decided to shut down the TPS units 5 weeks later, and they were never restarted.)

Also in March, the prime hired a consultant specializing in vibration analysis to assess the bearing failures. The consultant identified two principal causes of the failures:

Time Line of Major TPS Events	
September 1997	<ul style="list-style-type: none">Contract awarded.
March 1998- April 2000	<ul style="list-style-type: none">94 TPS units are installed
July 1998	<ul style="list-style-type: none">Two units experience computer card failures.
May 1999	<ul style="list-style-type: none">NOAA withholds payment for defective units at 4 sites.
October 1999	<ul style="list-style-type: none">Two catastrophic bearing failures occur.
November 1999	<ul style="list-style-type: none">COTR sends first letter of concern to prime contractor.
December 1999	<ul style="list-style-type: none">TPS issues meeting is held with NOAA, prime contractor, subcontractor.Subcontractor sends corrective action plan to prime contractorNOAA withholds payment for defective units at 5 sites.Prime contractor sends proposed action plan to correct rotary and states it plans to submit a VECP (for a static TPS).
January 2000	<ul style="list-style-type: none">NOAA Acquisition sends second letter of concern to prime contractor.Three catastrophic bearing failures occur.NOAA withholds payment for defective units at 3 sites.
February 2000	<ul style="list-style-type: none">Prime contractor responds to letter of concern stating it is not ready to submit a corrective action plan.Prime contractor submits draft VECP to complete contract with its static TPS.Two catastrophic bearing failures occur.Subcontractor provides assurance that catastrophic failures do not pose a safety risk.NOAA withholds payment for defective units at 5 sites.
March 2000	<ul style="list-style-type: none">Prime contractor hires vibration consultant to assess problems with rotary TPS.Subcontractor sends letter to prime contractor recommending shutdown of fielded TPS units until corrections to avoid bearing failures are made.Prime contractor recommends shutdown of fielded TPS units until all known deficiencies are corrected.

¹⁷ At that point, 50 units had not been deployed, of which 33 had not yet been ordered. The draft VECP identified the specification requirements that would have to be changed to allow a static TPS to be used and proposed two alternatives: substitute the static TPS for all 50 remaining units or substitute the static TPS for the 33 units that had not been ordered.

¹⁸ Firmware is software (programs or data) that has been written onto read-only memory. Firmware is a combination of software and hardware.

(1) excess vibration from TPS' aluminum construction and poor motor field control, and (2) insufficient bearing lubrication. In an April 7 report, the consultant made four major recommendations that it believed would solve the problems:

Time Line (continued)	
April 2000	<ul style="list-style-type: none">• Vibration consultant submits report with recommendations for correcting rotary TPS problems.• NOAA Acquisition sends first cure notice to prime contractor.• Subcontractor provides corrective action plan to prime contractor, which includes corrections recommended by the vibration consultant and reiterates the need for authorization to implement corrections so that TPS units avoid bearing failures.
May 2000	<ul style="list-style-type: none">• Prime contractor responds to cure notice with corrective action plan, but notes that it may be impossible or commercially impractical to meet the requirements.• Technical interchange meeting is attended by government, prime contractor, and subcontractor to discuss corrective actions. Use of prime contractor's static TPS is also discussed.• NOAA Acquisition officially requests alternative action plan for static TPS.• ROC orders immediate shutdown of rotary TPS units.• Prime contractor receives order for two static TPS units for testing at ROC and El Paso.• Prime contractor submits VECP for static TPS and corrections to rotary TPS.
June 2000	<ul style="list-style-type: none">• ROC tests static TPS at El Paso, Eglin AFB, and Laughlin AFB.• Subcontractor sends letter to prime contractor stating it has received no detailed information on government's issues with corrective action plan.• Two FAA units successfully complete factory acceptance testing (without permanent corrections).• FAA provides briefing information to NWS urging continued consideration of rotary TPS.• Subcontractor offers NOAA a direct procurement option.

- Replace the aluminum motor end bell¹⁹ with iron.
- Improve the firmware for better motor field control.
- Improve vibration monitoring.
- Install a system to continuously lubricate the bearings.

(The rotary subcontractor's perspective on the bearing problem is discussed on page 14.)

On April 19, NOAA Acquisition sent a cure notice to the prime citing failure to comply with the contract's specifications in three areas: step load response, reliability, and vibration, the latter two areas addressing the bearing issues. The notice stated that NOAA had not received an acceptable corrective action

plan to remedy the deficiencies identified in the two previous letters of concern, and that a decision about the shutdown would be made after it had received the corrective action plan.

Subcontractor's Corrections Rejected

On April 27, the subcontractor provided a corrective action plan to the prime that addressed the problems in the cure notice, including implementing the recommendations of the vibration consultant. The subcontractor reiterated that it had demonstrated corrections that, if made, would allow the units to operate without further catastrophic failures until permanent corrections could be devised, but noted that it had been denied authorization to implement them. The subcontractor wanted to provide these corrections at no cost and to ship them to the NEXRAD locations for installation by government site technicians, and had previously assured NWS that operating the units would not pose a safety hazard. The prime's May 4 letter to NOAA Acquisition responding to the cure notice discussed actions to correct the rotary TPS—including the no-cost interim corrections proposed by the subcontractor—but also stated that in the case of step load response and the bearing relubrication system, it might be impossible or commercially

¹⁹ An end bell is the housing at the end of the motor that joins the electrical connections with the motor.

impractical to meet the requirements of the specification. The letter offered no explanation for these assertions.

A technical interchange meeting was held on May 4-5, attended by all of the parties. The meeting covered, among other things, the actions being taken by the subcontractor to solve the problems and a demonstration of its prototype relubrication system. The alternative of using the prime's static TPS was also discussed. According to our interviews, NOAA representatives left the meeting believing that the relubrication system and other proposed corrections were crude and not worth pursuing. On May 8, NOAA Acquisition officially requested an alternate action plan for a static TPS, and on May 9 the ROC ordered immediate shutdown of the

rotary TPS units, rather than authorize the corrections aimed at preventing further catastrophic failures and allowing the units to resume operations. On May 12, the prime received an order for two of its static TPS units to be installed at the ROC and El Paso for testing.²⁰

NWS's decision against authorizing the interim corrections remains perplexing in light of the benefits provided by the rotary TPS units: when these units successfully operated at sites with poor power quality, component failures were significantly reduced. According to the ROC, maintenance costs at these sites decreased on average by \$2,300 per site per month. Although there is some indication that the interim corrections may have needed refinement, savings of this magnitude would make efforts to resume operations of the rotary TPS—until its problems were permanently resolved or an alternative was implemented—seem highly desirable.

B. The TPS Acquisition Shifted Emphasis from Rotary to Static TPS

The prime communicated the government's lack of confidence in the rotary TPS corrections in a letter to the subcontractor after the May meeting, and from that time on appeared to focus on promoting its own static TPS and to make no further effort toward supporting improvements to the rotary. Meanwhile, the subcontractor continued to develop, test, and evaluate solutions to the rotary TPS problems.

Time Line (continued)

July 2000

- NOAA Acquisition sends second cure notice to prime contractor and requesting explanation of why any work is considered outside contract scope or price.
- Prime contractor responds to cure notice and states "technical impossibility" argument.

July–August 2000

- ROC tests static TPS at Vance AFB.

August 2000

- NOAA Acquisition sends letter addressing prime contractor's response to the second cure notice, which states that the government is not convinced the specification cannot be met.

August–September 2000

- Prime contractor submits proposals for retrofit of rotary TPS and static TPS alternative.

September 2000

- NOAA Acquisition sends letter to the prime contractor transmitting specification for a static TPS and requesting proposal by October 11.

October 2000

- Prime contractor submits proposal for static TPS.

November 2000

- Subcontractor sends letter to prime contractor stating that it has received no information since May meeting.
- FAA deploys first new rotary TPS. Units had permanent firmware corrections; FAA had not yet decided to utilize relubrication system.
- Modification 0022 to purchase static TPS executed.

²⁰ These units were purchased from the GSA schedule. On July 7, NOAA ordered additional static TPS units for Eglin AFB, Laughlin AFB, and Vance AFB.

On May 25, the prime submitted a second VECP, this one the alternate action plan that had been requested, and met with the government the following week to discuss it. Although it included an option to continue with the rotary TPS, the VECP focused on using the prime's static unit for all TPS installations, arguing that it provided the best option for performance, reliability, and life-cycle cost, and offered the lowest schedule risk. Substitution of the static TPS would have carried an increased cost to the contract of \$5.4 million, but the prime contractor offered a management deduction "in the interest of maintaining an excellent working relationship with the Government," bringing the price tag down to \$4.5 million. Correcting the rotary TPS carried an increased cost to the contract of \$3.1 to \$3.9 million, depending on whether the fielded units were retrofit on-site or in the factory, and did not include a discount.

On June 5, the subcontractor sent a letter to the prime objecting to its failure to support its corrective actions or make a good faith effort to resolve the issues. The letter said that the prime had provided no detailed information on the nature of NWS' concerns, and it objected to the prime's characterization of the corrective actions to NWS as "band-aid fixes." Finally, the letter stated that the prime's efforts to undercut the credibility of the proposed corrective actions began to intensify at about the time it became aware of the government's intent to request alternative TPS solutions.

The subcontractor wrote directly to the NOAA contracting officer on June 14, forwarding the June 5 letter. The subcontractor again said that it had not received any detailed information concerning the government's lack of confidence in the corrective actions and described its contract with FAA, indicating that two FAA units had successfully completed factory acceptance testing without discrepancies. The subcontractor offered NOAA a direct procurement option and provided a rough cost estimate in an attempt to ensure that its solution would be fully and fairly considered. Since NOAA had no direct legal relationship with the subcontractor, it was under no obligation to respond and did not do so.

Contract requirements, costs modified

On July 19, the contracting officer sent the prime a second cure notice stating that it was troubled by the prime's offer to provide what NOAA believed was required performance under the contract at an increased price. The contracting officer requested a detailed explanation of the reason why any of the work was considered outside the scope or price of the contract. In a July

Rotary Subcontractor's Perspective on Bearing Problem

Lubrication

The vibration consultant recommended using iron end bells to reduce vibration. The subcontractor used ductile iron in its COTS units, but had substituted aluminum for NWS in order to satisfy the weight limit in the TPS specification.

The subcontractor believed that insufficient lubrication, rather than vibration, was the principal cause of the bearing failures, and did not believe iron end bells were needed, although they were offered to NOAA as a corrective action. The subcontractor took this position because some of its COTS units, which used ductile iron and thus did not have the vibration problem, also needed premature bearing replacements.

Possible Shipping Damage

The subcontractor believed a possible contributor to the bearing problems and other system failures was mishandling by another subcontractor responsible for shipping the TPS units to the NEXRAD sites. Before delivery, the rotary subcontractor placed shock watches on the units—devices that are tripped if cargo has been exposed to excessive shock or impact.

A log was to be filled out indicating the condition of the shock watches at each stage of delivery. However, this information frequently was not recorded, and removing the shock watches could cause them to trip, making it difficult to determine if or when a problem occurred. In addition, the prime contractor argued that the shock watches had been set improperly and would not accurately indicate shipping damage.

As a result, it was not possible to determine whether mishandling during shipping had caused damage to the bearings or other TPS components.

28 letter, the prime identified TPS requirements that it maintained were impossible to perform. The contracting officer's response on August 15 stated that the government was not convinced the specification could not be met. It referred to the fact that testing of the older model rotary TPS did not identify any unachievable requirements, and it pointed out that the government had allowed reductions in capability to accommodate the TPS that was chosen. As discussed in finding V (pages 38-39), we do not find the prime's arguments convincing, but this letter was NOAA's only attempt to formally refute them.

On September 26, NOAA Acquisition transmitted a TPS specification to the prime that had been revised to accommodate the proposed static unit and requested a change proposal by October 11. Contract modification 0022 was executed on November 29, 2000, to incorporate revised specifications for the prime's static TPS into the contract and to establish a formal written compromise of all outstanding contract issues to date.

Meanwhile, the subcontractor wrote to the prime on November 1, stating that it had received no information since the May meeting and summarizing the results of its efforts to correct the rotary TPS deficiencies. The letter pointed out that two FAA units had successfully completed all factory and on-site testing, and were supporting two NEXRAD systems in Alaska, one in Kenai and the other in Fairbanks. It also noted that commercial deployment of the relubrication system was underway. NOAA had been informed of the FAA units' completion of factory testing in the subcontractor's June 14 letter, but it is unclear if it was aware that by November, two were operating in Alaska. In June 2000, FAA had urged NWS to monitor the subcontractor's progress before reaching a decision. However, NWS did not do this, nor did it follow up with FAA on the progress of its rotary TPS acquisition.

Rotary TPS units may have a higher initial cost than static units, but they frequently have lower recurring cost, making them less expensive on a life-cycle basis. NWS' analysis of life-cycle costs did not yield this result, which may have contributed to its decision to abandon the rotary. NWS concluded that between FY 2000 and FY 2021, the static TPS would cost about \$14 million less than the rotary. However, the validity of the analysis is questionable because it assumed there would be little, if any, improvement in the efficiency and reliability of the rotary TPS.

Only the Prime's Static TPS Evaluated

While we agree that it was appropriate for the prime and NOAA to investigate alternatives to the subcontractor's rotary TPS in view of its history of problems, it is troubling that the only alternative ever offered by the prime or evaluated by NOAA was the prime's own product. Moreover, NOAA failed to seriously examine alternative static TPS technology that is arguably better suited to NEXRAD, as discussed in finding III (pages 20-25).

It appears that even during source selection, the prime viewed its static TPS solution as a possibility, and it attempted to propose this technology during best and final offers. NOAA rejected the attempt at that time as being too late and too disruptive. During our fieldwork, we were told that after the contract was awarded, the prime's marketing personnel would mention using the company's static TPS to NOAA staff, although the contractor's TPMS program team did not raise this topic.

Conclusion

Based on our analysis, we conclude that it was in the prime's interest to sell its own static TPS to NOAA, and that it was convenient for NOAA to purchase this TPS using the TPMS contract rather than seek other alternatives. Thus, the prime and NOAA lacked incentive to closely monitor and thoroughly evaluate the subcontractor's progress in implementing corrections to the rotary TPS or to evaluate other static options. Although it cannot be known what NOAA would have chosen to do if these actions had been taken, whatever choice it ultimately made—whether to continue with the rotary TPS, acquire the prime's static TPS, or purchase a different static TPS—would have been more supportable.

Recommendation

The Assistant Administrator for Weather Services and the Director of NOAA's Acquisition and Grants Office should ensure in future NWS acquisitions that all reasonable alternatives for the items being procured are identified, thoroughly analyzed, and well documented.

Synopsis of NOAA's Response

NOAA stated that the first two rotary units installed had performance and reliability problems, which were discussed with the prime as early as May 1998. The response described a visit by ROC engineers to the subcontractor's factory in July 2000 where they saw an FAA unit without the permanent corrections being tested. In addition, NOAA indicated our discussion of the vibration consultant's recommendations is incomplete and inaccurate and advised us to include the recommendations verbatim. The response also stated that the aluminum construction did not technically cause the vibration in the rotary TPS, but rather resonance at 120 Hz, which NOAA asserted could have been avoided had the subcontractor checked the overall design for resonance.

In discussing reasons why interim corrections were not installed, NOAA said (1) the corrections failed to perform, (2) NWS field technicians were not qualified to install them, (3) continuing to operate the rotary TPS units might endanger staff, and (4) continued TPS usage would limit the government's rights for future contract decisions.

NOAA stated that the change to the prime's static was the best-value business decision, arguing that it was in the government's interest to install a reliable TPS, the interim fixes provided no improvement in rotary TPS performance and reliability, and the permanent corrections were not yet available and tested on the FAA model ROC engineers saw in the subcontractor's factory in July 2000. NOAA further stated that the prime contractor's TPS was compatible with NEXRAD, and the competing static TPS was more costly and could not have been installed as quickly as the prime's unit. Consequently, the government would have foregone the financial benefits of lower operations and maintenance costs and the operational benefits of avoiding computer restarts and lost data caused by commercial power anomalies.

According to the response, FAA's rotary TPS units require yearly bearing changes, as well as frequent maintenance of the relubrication unit. It further stated that FAA engineers on site

during installation of rotary units advised NOAA that the subcontractor routinely ships rotary units with old bearings and changes them on site. NOAA further asserted that at the May 8, 2000, meeting, the subcontractor had recommended yearly bearing replacement for the NEXRAD units once the relubrication system was installed.

Finally, the response maintained that NWS seriously examined alternative static units. It stated that after a visit by a manufacturing representative for the competing static unit, NWS intended to purchase this unit for testing, but decided not to after concluding that the testing could be interpreted as directing the prime's engineering solution.

OIG Comments

To address NOAA's point that the rotary TPS experienced problems early in the acquisition, we have added the earliest documented failures to the chronology presented in this finding. These failures reinforce our argument in finding I (pages 7-8) that the rotary TPS selected was immature and unproven and the decision to acquire it should have been more carefully considered. We have made changes to the finding to address when the initial FAA units received permanent corrections.

During our review we extensively questioned NOAA engineering, management, and contracting staff about the nature and progress of the permanent corrections the subcontractor was making to the rotary units. Never was a July 2000 visit to the subcontractor's factory ever mentioned. Equally troubling was the lack of information in the contracting officer or COTR's files documenting findings or issues from that visit.

While it is true that FAA's units were not being tested with the corrections at the time the July visit would have taken place, ROC engineers visiting the factory could have examined and reported on a relubrication system being tested on a commercial unit. An internal memorandum prepared by the subcontractor, dated July 5, 2000, states that the relubrication unit could be ready for field deployment for NWS or FAA units within 2 to 3 weeks of an order to perform work.

We believe our report accurately summarizes the pertinent recommendations of the vibration consultant. Regarding whether the aluminum construction caused the vibration, the consultant's testing found the resonant response at 120 Hz to be the primary cause of the vibration and to occur where the aluminum end bell was used, but not with the ductile iron end bell. As noted, the consultant specifically recommended replacing the aluminum with iron. We believe our characterization is accurate. Finding VI (page 42) points out that NWS should have validated the weight requirement—which was the reason the subcontractor deviated from its commercial practice and substituted aluminum for iron in NWS' TPS—and if it was needed, should have been proactive in ensuring that an analysis of the potential effects of substituting aluminum was performed *before* agreeing to its use.

Our report clearly acknowledges that the interim corrections needed refinement, but were worth pursuing because of the known benefits of reactivating the TPS units. According to the subcontractor, the proposed corrections were simple installations that any electronics technician would be capable of handling, and the subcontractor had intended to assist the technicians through telephone support. Highly trained NEXRAD technicians surely would not have found

these installations onerous. As the report notes, personnel safety does not appear to have been an issue as the subcontractor had assured NWS (in writing) that the operation of the rotary units posed no hazard. Although NOAA's response asserted that limiting the government's rights for future contract decisions was a consideration, again, no one we interviewed ever indicated this had been a factor at the time in rejecting the interim corrections, and we found no documentation in either the contracting officer or COTR's file to support this argument.

As discussed in finding III (pages 21-23), the specification for reflected THD was relaxed well beyond IEEE recommended practice in order to accommodate the prime contractor's static TPS. Although as NOAA's response pointed out, the competing static unit is more expensive to acquire initially, NWS did *not* perform a life-cycle cost analysis of the competing static unit and thus, did not, in fact, know whether it actually is more costly over its life cycle. Moreover, overall costs to NWS are increased if the engine generator or other system components have to be replaced prematurely.

One of NOAA's principal rationales for its decision to abandon the rotary and adopt the prime's static TPS was speed. According to NOAA, acquiring the prime's unit was the quickest solution for obtaining the benefits of a reliable TPS—quicker than allowing the subcontractor to implement corrections on the rotary TPS or purchasing a competing static unit. We question whether haste was justified. As we have seen, little effort was made to support the improvements to and installation of the interim corrections, which would have allowed 94 NEXRAD sites to continue to benefit from TPS protection. Furthermore, the ROC's own reliability data shows that it takes an average of 10 days to repair a static TPS unit and place it back on-line.²¹ A delay of this duration is not typically tolerated for a critical system component.

According to FAA headquarters personnel responsible for the rotary TPS contract, the agency has experienced no bearing problems on its rotary units, and plans to replace the bearings every 5 years, not annually as asserted by NOAA. FAA decided to have the bearings changed before units were placed in service initially to reduce the chance of failure due to damage during shipment. Also when units are not operating, bearings have to be rotated every 30 days, and shipment and installation can take longer than that. Maintenance of the relubrication system consists of replacing the batteries and reloading the lubrication canister. When the systems were first installed, a 6-month maintenance schedule was used due, in part, to several battery failures. This problem has been corrected, and maintenance of the relubrication system is now performed annually with the rest of the system.

NOAA's belief that the subcontractor had recommended yearly bearing changes with the relubrication system appears to be a misunderstanding. In a letter to the prime, the subcontractor offered to warrant the bearings on the NWS rotary units for 3 years after the relubrication system was installed, and also stated that it was willing to replace them on an annual basis at no cost if necessary.

Finally, it is difficult to understand how receiving a marketing visit from a manufacturing representative and intending to test the competing static unit, but not actually doing so, can be described as a serious examination of alternatives. Asking the prime to test additional units in

²¹ This statistic refers to the length of time it takes to fix failures that prevent the TPS from operating.

order to determine best value—without requesting particular brands—would not be directing a solution, as NOAA stated, but rather managing the contract responsibly.

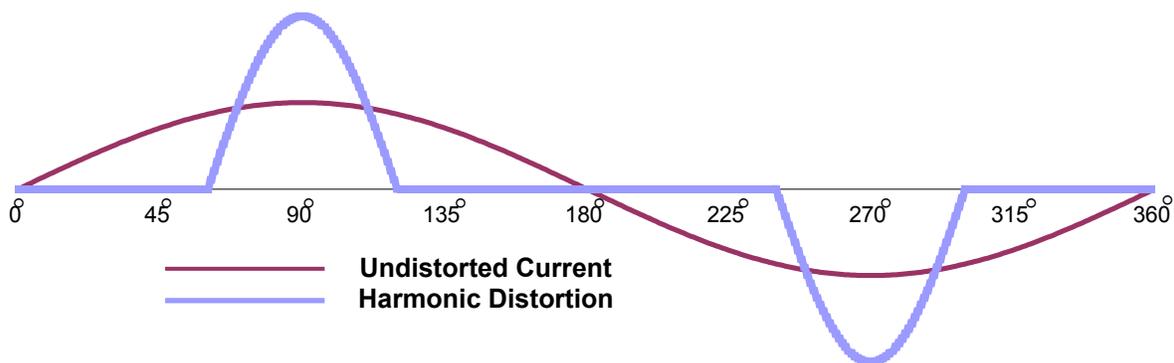
III. The Prime's Static TPS May Not Be the Most Appropriate Choice for NEXRAD

Concern about the compatibility of the static TPS with the engine generator was a principal reason for the ROC initially concluding that static technology would be problematic for NEXRAD. More recently, newer static technology, which solves the engine generator compatibility problem, has become commercially feasible. As noted earlier, however, in deciding to switch to the static TPS, NOAA evaluated only the prime's unit and did not perform an analysis of other static alternatives. The static TPS purchased does not use the newer technology and may be less suitable for NEXRAD than other units on the market. It also appears to be significantly less reliable.

Engine Generator Compatibility

A major challenge in the design of electric power systems is controlling reflected harmonic distortion (see figure 3). Static TPS technology available when the ROC performed its initial engineering assessment used a 6-pulse silicon controlled rectifier (SCR). This technology produces high levels of harmonic currents or harmonic distortion, which can be reflected back to the power source, including to the engine generator, and cause high voltage distortion. Consequences of high current and voltage distortion include overheating of conductors and motor windings, and instability in voltage and frequency regulation. Other potential effects include reduced efficiency and service life of the engine generator, as well as problems with other system components such as power supplies, variable speed motors, power factor improvement or filter capacitors, air conditioner controls, and in severe cases, cables and wiring. Total harmonic distortion (THD) is the measure used to define the effect of harmonic distortion on power system voltage or current.

Figure 3: Example of Harmonic Distortion
Undistorted alternating current has the shape of a sine wave. In the U.S., alternating current is usually generated at a frequency of 60 hertz, called the fundamental. Harmonic distortion is any deviation of current or voltage from the fundamental and has a frequency that is an exact multiple of 60 hertz. Nonlinear loads—such as the 6-pulse SCR—draw a nonsinusoidal current when supplied by a sinusoidal voltage source and produce harmonic distortion.



Because of the importance and complexity of controlling harmonics, the Institute of Electrical and Electronics Engineers (IEEE) developed Standard 519-1992, *IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems*, to guide the design of power systems with nonlinear loads.^{22,23} Systems incorporating 6-pulse SCR units often oversize the engine generator as a means of avoiding harmonic heating and instability. However, one of the constraints placed on the selection of TPS technology for NEXRAD was that—to avoid additional costs—existing engine generators were not to be replaced. Based, in part, on the technology available for assessment at the time the ROC performed its initial engineering analysis and on the engine generator sizing issues, ROC engineers concluded that static technology probably was not feasible using a commercial product. The IEEE standard, as applied to NEXRAD, establishes a maximum limit of 5 percent for current THD, and consistent with this standard, the original TPS specification allowed a maximum current THD of 5 percent.

Since the time of the ROC's TPS evaluation in the early 1990s, a newer rectifier design has become available. This design uses insulated-gate bipolar transistor (IGBT) semiconductors, and reduces reflected current THD to benign levels, virtually eliminating engine generator incompatibility problems and the need to oversize the engine generator. However, the prime's static TPS uses a 6-pulse SCR and consequently produces high levels of current and voltage THD.

The results of testing the static TPS with NEXRAD at the ROC in May 2000 were documented in a test report. According to the report, the TPS exhibited no problems. However, voltage THD reached almost 19 percent, and current THD exceeded 10 percent.²⁴ The ROC's analysis of the harmonic issues found that although the TPS was equipped with an input filter that reduces current THD, its use impaired the engine generator's voltage regulation, potentially causing over-voltage and shutdown, so the report recommended the filter not be used. The report said that the voltage THD effects may not be detrimental because the load on the engine generator is relatively light (50 percent of rated capacity), and impacts are typically experienced when the engine generator is operated near or at its rated capacity. The report indicated that ROC engineering personnel were working with the engine generator manufacturer to determine whether any detrimental effects could be expected. The report recommended that the static TPS be installed at several field sites for long-term testing, optimally 6 months, to detect possible problems.

The test report recognized that voltage THD was well above the IEEE standard for harmonic control, but stated that the standard is primarily intended as guidance for utility power operations. However, high current and voltage THD can cause problems for any power system with nonlinear loads, and the standard states that it is to be used for guidance in the design of such systems.

After analyzing data from the ROC's testing and from a radar system power demand profile provided in May 2000, the engine generator manufacturer advised that it would generally size a

²² The Institute of Electrical and Electronics Engineers, Inc., 1993. *IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems*, IEEE Standard 519-1992. New York: IEEE.

²³ A nonlinear load draws a nonsinusoidal current when supplied by a sinusoidal voltage source.

²⁴ Current THD was not presented in the test report but identified in a letter to the engine generator manufacturer.

larger generator for the particular TPS in question, but stated that it saw no problems with generator performance or life due to harmonic heating. This conclusion was based on the current and voltage THD produced during testing at the ROC, and the assumption that the TPS and the engine generator loads would be relatively light.

Rather than the 6 months recommended in the test report, testing was performed for between 4 and 12 days each at four additional sites—El Paso, Eglin Air Force Base (AFB), Laughlin AFB, and Vance AFB. No test report was prepared, but available data shows THD levels even higher than those at the ROC:

- El Paso had maximum voltage THD of 25 percent, and
- Eglin AFB had maximum current THD of 26 percent and maximum voltage THD of 15 percent.

Although most NEXRAD systems use the same engine generator, the first 10 radar systems to be fielded were equipped with a different brand, including the system at Eglin AFB. In August 2000, the ROC requested input about THD effects on that engine generator and provided data from the Eglin AFB test. The manufacturer's sizing program indicated that the engine generator size was sufficient, but this conclusion appears questionable because the materials provided in the manufacturer's response show that the analysis erroneously assumed the static TPS was using a 10 percent THD input filter.

As shown in table 1, the prime's first VECP in February 2000 indicated that its static TPS had reflected maximum current THD of 10 percent and did not meet the specification requirement for a maximum of 5 percent. This information was repeated in its May 2000 VECP and was apparently based on the assumption that the THD input filter would be used. A maximum current THD level of 10 percent would probably not have been a major concern if voltage THD did not exceed this level, and is within the tolerance FAA has established for its electronic equipment.²⁵ However, the testing found the THD input filter could not be used.

Table 1 shows that as the actual amount of reflected current THD became apparent to NWS, the permitted level changed accordingly. In September 2000, NOAA Acquisition transmitted a revised specification to the prime with its request for an alternate proposal. In the revised specification, the requirement for reflected current THD was increased from a maximum of 5 percent to a maximum of 20 percent. Another specification change was that current THD was to be measured at full radar load rather than at any load factor, an additional relaxation since 6-pulse SCR systems produce their lowest levels of current THD at full radar load, with the level increasing as the load declines. By the time contract modification 0022 was executed, the requirement had been relaxed further. Specifically, although current THD remained at 20 percent, the allowable amount had actually been increased because the requirement specified an average value instead of a maximum amount. In addition, a limit on voltage THD was added to the specification—an average of 15 percent—for contract modification 0022. We could find no reason for why these changes would have been made except to accommodate the actual performance of the prime's TPS with NEXRAD.

²⁵ Department of Transportation, October 22, 2001. *FAA Specification, Electronic Equipment, General Requirements*, FAA-G-2100G. Washington, DC: DOT.

Table 1: Evolution of Harmonic Distortion Requirement in Specification

Date	THD Percent		Maximum or Average THD Percent	Radar Load Factor*	Source
	Current	Voltage			
November 1996	5	Not specified	Maximum	Any	Original specification
February and May 2000	10	Not specified	Maximum	Any	VECPS
September 2000	20	Not specified	Maximum	Full	Draft specification with request for alternate proposal
November 2000	20	15	Average	Full	Revised specification for contract modification 0022

*THD is lowest at full radar load for 6-pulse SCR technology and increases as the load declines.

NWS justified its decision to purchase a system with harmonic distortion well in excess of recommended industry practice on the basis of the opinions of the engine generator manufacturers that it would do no harm to the engine generators. However, the current THD limits in the revised specification are significantly higher than those on which one manufacturer based its opinion, and the other manufacturer's opinion is questionable because its calculations incorrectly assumed that the THD input filter was being used.

NWS officials indicate that the engine generator is working well with the static TPS and no negative effects have been observed. Nevertheless, the long-term effects of high harmonic distortion on component service life remain uncertain. In addition, since the service life and performance of the engine generator depend on both itself and the TPS being lightly loaded, NWS will have to carefully plan and monitor power system impacts when enhancing radar functionality or equipment. Under these circumstances, what makes the decision to accept the prime's TPS for NEXRAD particularly dubious is the fact that other static TPS units that permit consistency with recommended engineering practices and do not present these potential problems were available at the time the decision was made, but no static TPS other than that of the prime was evaluated.

Reliability

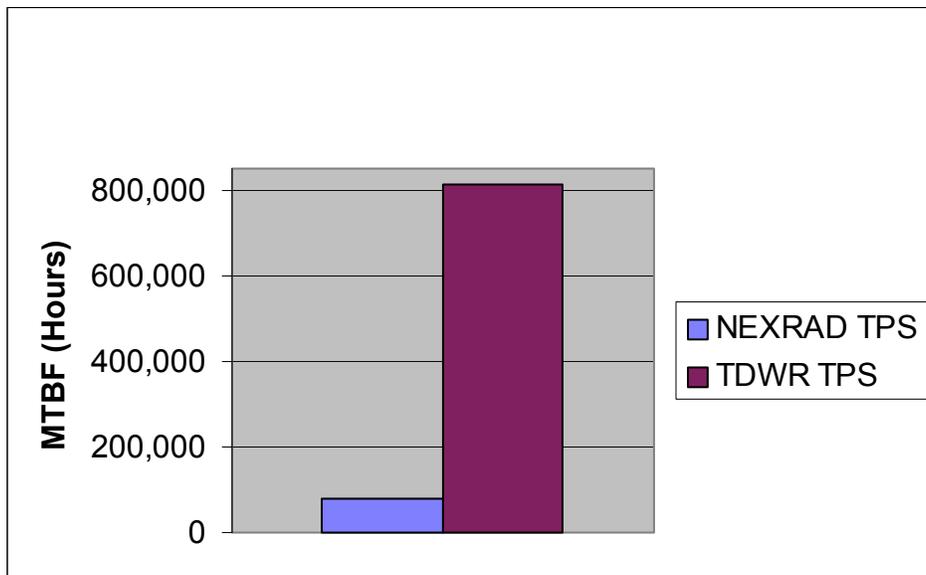
Because the FAA has extensive experience using static TPS units on its weather and surveillance radar systems, it would have been a source of valuable information on the issues involved in selecting a static TPS to replace the rotary TPS. Particularly pertinent is FAA's experience on TDWR, a weather radar similar in design to NEXRAD. To avoid outages caused by commercial power losses, FAA installed static TPS units on 45 TDWR systems between 1998 and 1999. Located near high-activity airports, TDWR systems disseminate real-time warnings and advisories to aviators and air traffic control decision-makers. However, NWS did not investigate

FAA’s experience. During our fieldwork, the former COTR for the TPMS contract dismissed the static TPS used on TDWR, stating it had reliability problems and was less efficient than the static TPS being purchased for NEXRAD.

FAA personnel on the TDWR product team, as well as engineers involved in FAA agency-wide power systems acquisition, management, and operations told us, on the contrary, the TPS has performed extremely well and is highly reliable. Before deploying this TPS, FAA tested one of the TPMS prime’s static units on TDWR. According to FAA’s test report and FAA personnel involved in the testing, this TPS had performance and maintainability issues that made it less desirable for TDWR.

Furthermore, a comparison of the reliability data collected by FAA and NWS indicates that FAA’s static TPS is far more reliable. As of January 6, 2003, TDWR TPS units had experienced 2 relevant failures in more than 1.6 million hours of operation,²⁶ while as of January 31, 2003, NEXRAD static TPS units had 19 relevant failures in fewer than 1.5 million hours of operation.²⁷ As shown in figure 4, the mean time between failure (MTBF) for the NEXRAD TPS is more than a full order of magnitude less than that of the TDWR TPS (over 800,000 hours for FAA’s TDWR units as compared to less than 80,000 for those of NWS).

Figure 4: Comparison of Mean Time Between Failure for NEXRAD and TDWR Static TPS



²⁶ Relevant failures cause the TPS to go into bypass (i.e., to no longer supply the load). Excluded are externally induced failures such as faulty wiring or instances in which the TPS goes into bypass and then recovers, and instances of “infant mortality” (i.e., early life failures that are not included in determining reliability). One failure identified as relevant for FAA is not actually considered to be a relevant failure by some cognizant FAA personnel, but we presented the more conservative position.

²⁷ This number excludes environmental control unit failures.

Battery reliability was a concern in originally selecting TPS technology and was one of the reasons why a rotary TPS, which does not have batteries as a major component, was preferred. Repeated demand on the battery, potentially reducing battery life, will occur if there are frequent power quality problems. A briefing prepared by the ROC on the technical issues affecting the TPS acquisition strategy noted that many sites are located at the end of long rural power lines and have poor power quality.²⁸ According to the briefing, these sites can experience numerous power outages and anomalies daily, and it noted that a test conducted at the Salt Lake City NEXRAD site found up to 40 power outages and brownouts per day.

The revised TPS specification requires the batteries to be capable of at least 200 complete full-load discharge cycles,²⁹ and according to OOS engineers, batteries are expected to last 3 to 5 years. However, 5 of the 19 relevant failures reported for the NEXRAD TPS were battery failures, and they occurred on systems that had been in operation from about 1½ to 2 years. Three of these failures occurred at sites in mountaintop or rural areas—one in Salt Lake City and the others in Aberdeen, South Dakota, and Billings, Montana. The other failures were at Edwards AFB and San Joaquin, California. In contrast, the TDWR TPS experienced no battery failures in the time frame covered by our analysis. This may be attributable, in part, to the fact that they are located near busy airports, which unlike many NEXRAD locations, are not likely to have power quality problems. Another factor may be that—according to the manufacturer of the TDWR TPS—TPS technology with the newer rectifier design extends battery life because step loading does not drain the batteries. The same brand of TPS as on TDWR is used as an uninterruptible power supply in some weather forecast offices, and there have been recent reports of early battery failures on some of these units as well. Thus, the reasons for the premature battery failures are unclear, and NWS plans to look into this issue further.

FAA personnel emphasize that their perspective is not intended as criticism of the TPMS prime's product in particular, but is the consequence of the inferior performance of 6-pulse SCR technology, regardless of manufacturer, with FAA radar systems.

Inadequate Evaluation Process

We could not evaluate the former COTR's assertion that the TDWR TPS was less efficient because we could not find comparable data on the efficiency of the two TPS systems. The important factors to consider in assessing alternatives, however, are the performance, reliability, maintainability, and life-cycle costs, as well as benefits and problems of the system as a whole, not just isolated system characteristics. Although the high level of harmonic distortion and the disparity in reliability between the NEXRAD TPS and TDWR TPS cause us to question the choice that was made, it is not within our domain to determine the most appropriate TPS for NEXRAD. Thus, our intent is not to apply hindsight to that choice but to highlight the inadequacy of the evaluation process, which, given the information presented above—information that was available when NOAA decided to acquire the prime's TPS—casts serious doubt on the outcome.

²⁸ L. Carvajal, November 28, 1995. *TPS Technical Issues Affecting Acquisition Strategy*, Norman, and OK: WSR-88D Operational Support Facility.

²⁹ A battery cycle is a discharge plus a charge.

Recommendation

As in finding II (page 16), we recommend that the Assistant Administrator for Weather Services and the Director of NOAA's Acquisition and Grants Office ensure in future NWS acquisitions that all reasonable alternatives for the items being procured are identified, thoroughly analyzed, and well documented.

Synopsis of NOAA's Response

NOAA stated that the prime's static TPS was proven and stable technology that met reliability and performance specifications. NOAA indicated that subsequent reliability data over 1.9 million hours of operation as of June 30, 2003, shows it is compatible with the engine generator. Reflected THD for the competing static unit is 5 to 7 percent according to its specifications and will be higher for a dynamic load like NEXRAD. NOAA indicated that the testing data for El Paso does not show voltage THD of 25 percent, as presented in the report; rather, it said that no voltage THD values above 20.6 percent were found.

According to the response, the change in the reflected harmonic distortion specification allowing it to be measured at full radar load as opposed to any load factor is not a relaxation of the specification. Rather, it takes into account that the measurement has to be taken at full *radar* load and the NEXRAD load is very nonlinear. By specifying reflected THD at full radar load, NWS is ensuring that the TPS performs under operational loads rather than an artificial linear load as represented in a factory test.

NOAA believes that some of the differences in reliability between the TDWR and NEXRAD TPS are attributable to differences in commercial power quality: NEXRAD radars typically are located in rural areas with poor power while TDWR radars are in urban environments with much better commercial power quality. An additional reason for the differences in reliability, according to NOAA's response, is that NWS tests the TPS weekly for failures as part of an overall test of the emergency power distribution subsystem, allowing for the discovery and correction of TPS failures on a weekly basis. FAA, on the other hand, only reports failures discovered in actual operation of the TPS. NOAA stated that this means NWS may report more failures than FAA since FAA failures can go undetected for long time periods.

OIG Comments

Although NOAA's response states that the static TPS meets the specification, as we have noted in this finding, the prime's static TPS only does so because the specification was modified to accommodate the unit's extremely high levels of reflected harmonic distortion. The 1.9 million operating hours cited by NOAA is cumulative over all of the units in operation, but the duration of operation is still relatively brief for any one unit—less than 3 years. As the report points out, problems caused by reflected harmonic distortion can be long-term in the making and thus not yet apparent. However, we are aware of a problem at one site that NEXRAD technicians believe is caused by reflected harmonic distortion. This site's new air conditioning units intermittently shut down when the load is transferred to the engine generator while the TPS is on-line. The

technicians believe that reflected harmonic distortion is triggering the phase monitors (which check the power for abnormal conditions) to shut the air conditioning units down.

Although the newer technology static TPS does produce harmonic distortion, the levels are low and the deleterious effects are virtually eliminated. This is the case even when the TPS is operated with a dynamic radar load. The 25 percent voltage THD at El Paso that we discuss was documented in a briefing prepared by the ROC on the results of compatibility testing of the prime's static TPS with the NEXRAD radar. Even if that were not the case, the 20.6 percent that NOAA referenced is also excessive.

NOAA's response stated that by changing the specification for reflected THD to be measured at full radar load, NWS was not relaxing the specification, but ensuring the TPS performed under operational loads rather than under an artificial linear load as represented in a factory test. However, the original specification already required testing at no load, half load, and rated and required load. This means testing under operational loads was already mandatory and limiting testing to an artificial linear load had been precluded. Thus, ensuring realistic testing was not a valid reason for changing the specification.

Our report discusses the fact that some of the differences in reliability between the TDWR and NEXRAD TPS may be attributable to differences in commercial power quality. It points out that the poor power quality at some NEXRAD sites—which can reduce battery life—is a reason why rotary technology was preferred originally. However, 14 of the 19 failures addressed in this report for the NEXRAD TPS were not battery failures and are not attributable to power quality. FAA has both newer technology static TPS units and the prime's units operating at a variety of sites, including those with poor power quality; its power system experts have told us that the former are more reliable in all locations.

The TDWR TPS is used for power conditioning and therefore operates continuously; it also has a remote monitoring capability that detects failures when they occur. Thus, the differences in reliability cannot be attributed, as NOAA claims, to differences in frequency of operation or in detecting and reporting failures. If NOAA means that its units fail more frequently because weekly testing of the emergency power distribution subsystem is transferring operations from commercial power to the backup engine-generator, this is cause for concern. Protecting power loss to the radar during such power transitions is one of the principal functions for which the TPS was designed; testing this functionality should not induce failures.

IV. Unclear Accountability, Inadequate Information and Communication, and Insufficient Management Oversight Hampered Decision Making

The TPS acquisition lacked leadership and accountability. No one was clearly assigned responsibility for ensuring that management and technical decisions were well supported or that senior NWS officials were given complete and accurate information to enable effective oversight. These problems contributed to questionable decisions, as well as inadequate negotiations on modification 0022, as discussed in finding V (pages 31-39).

Unclear Accountability

Two geographically separated organizations within OOS were involved in the TPMS acquisition, the Maintenance, Logistics, and Acquisition Division at NWS headquarters in Silver Spring, Maryland, and the ROC in Norman, Oklahoma. This division of responsibilities made accountability and leadership ambiguous. For example, we asked various NOAA Acquisition and NWS managers and staff members involved in the TPMS program to identify the program manager and received the following answers:

1. ROC engineering branch chief
2. ROC deputy director
3. COTR
4. OOS director
5. An OOS Maintenance, Logistics, and Acquisition Division employee

The only document we could find that identified a program manager was the 1996 acquisition plan. However, the individual identified, an OOS engineer, told us that he is not the program manager, and he has not been functioning as such. After the contract was awarded in 1997, COTR responsibility was officially transferred from OOS headquarters to the ROC, but program management responsibility was not explicitly addressed and thus became unclear. As a result, there was a lack of leadership and accountability on the TPS acquisition.

Inadequate Information and Communication

Two key documents prepared by the ROC illustrate the decision-making information provided to NWS headquarters management, the first, a briefing presented to the Assistant Administrator for Weather Services on September 6, 2000, and the second, a memorandum for the Maintenance, Logistics, and Acquisition Division chief dated November 20, 2000. The objective of the briefing was to determine a strategy to move the TPMS program forward, while the memorandum attempted to justify the decision to procure the static TPS. These documents present the litany of problems experienced with the rotary TPS over the course of the contract, the actions taken to solve the problems, and the lack of proven solutions to several of them. They point out the solution to the bearing problem—the relubrication unit—was a factory prototype that was not field tested, and they convey an overall lack of confidence in the subcontractor’s ability to make the needed corrections.

FAA’s acquisition of the new rotary TPS was not addressed in these discussions. Two months before the briefing to the Assistant Administrator, two FAA rotary TPS units had successfully completed factory acceptance testing (without the permanent corrections, as noted previously). By the time of the memorandum to the division chief, FAA units were operating in Alaska with

the firmware corrections. The subcontractor had begun deploying the relubrication system commercially, although FAA had not yet decided to use the system on its units. However, NWS senior management officials were not made aware of this information.

FAA's experience was invoked, however, when it appeared to support use of the prime contract's static TPS, but the information provided was incomplete and in our opinion misleading. In arguing that using the static TPS was low risk, the briefing to the Assistant Administrator stated the static TPS was "Proven in Similar Applications (e.g., TDWR & ASR-9)."³⁰ Referring to the prime's static units that had been tested at five NEXRAD sites, the memorandum to the division chief asserted, "Units of this type are presently supplying power to similar FAA radars."

Absent, however, was information explaining the difference between the TDWR's static TPS and that of the prime—that is, that the former uses newer technology, which is free of harmonic distortion problems, while the latter produces harmonic distortion significantly in excess of recommended practice and that NWS' TPS specification was being considerably relaxed to accommodate the prime's older technology. These documents also failed to discuss FAA's experience with the prime's TPS on ASR-9, which showed these units to be less reliable than other commercially available units. Finally, the materials did not point out that FAA had tested the prime's static TPS with TDWR, but chose not to purchase it based on performance and maintainability issues.

It is unclear whether ROC personnel knew all of this information, but it is clear that a more vigorous effort to obtain the relevant facts and present them to headquarters should have been made. A possible reason for the incomplete information on FAA's use of static TPSs may be that the ROC relied on the representations of the prime, which stated in both of its VECPs,

The Federal Aviation Administration (FAA) utilizes static TPS units on their Terminal Doppler Weather Radar systems with very good success. [The prime] has installed these units at several FAA TDWR facilities.

These statements imply the prime's static units are operating on TDWR, but that is not the case. Rather, during our fieldwork, the prime told us the proposals were referring not to its own static TPS but to a competitor's unit, which the prime had installed. As the technical lead in acquiring the TPS, the ROC had an obligation to find out which TPS equipment FAA was using with its radar systems and what its experience had been, to use this information to help identify and assess alternatives, and to clearly and accurately communicate the findings to NWS senior management.

Insufficient Management Oversight

By the same token, management and technical oversight from headquarters was wanting. We could find no evidence that OOS management had ensured that headquarters engineering staff closely evaluated the information provided by the ROC or assessed the technical issues in order to make certain that NWS senior managers had the necessary information for oversight and decision making. Several headquarters engineers told us that after contract award, they moved

³⁰ ASR-9 is an FAA airport surveillance radar with a weather channel.

on to other assignments and spent little time on the project, and one told us that headquarters staff lacked the expertise to make their own judgments about the technical aspects of the TPS.

Thus, after contract award, it became unclear which person or organization within OOS was responsible for the TPMS program, resulting in a lack of management and technical accountability, leadership, and oversight. These conditions allowed decisions to be made with insufficient review, and incomplete and inaccurate information.

Recommendations

The Assistant Administrator for Weather Services should ensure that NWS managers take the following actions:

1. In future acquisitions of complex COTS or developmental items,
 - a. clearly assign and enforce program management accountability and responsibility, and
 - b. give management responsibility and technical leadership of the acquisition program to personnel with appropriate acquisition and technical expertise and experience.
2. In future acquisitions for NEXRAD,
 - a. effectively coordinate activities and share information between the ROC and headquarters, and
 - b. effectively coordinate activities and decisions, and share information among the NEXRAD tri-agency partners.
3. Ensure that COTRs are aware of their responsibilities and are held accountable for
 - a. achieving the cost, schedule, and technical performance goals of the contract and program;
 - b. making appropriate trade-off among these goals when necessary; and
 - c. providing clear and accurate information and advice to the contracting officer and senior program and agency officials.
4. Ensure that program managers are aware of their responsibilities and are held accountable for
 - a. achieving the cost, schedule, and technical performance goals of the contract and program;
 - b. making appropriate trade-off among these goals when necessary; and
 - c. providing clear and accurate information and advice to senior agency officials.

NOAA provided no specific comments on this finding.

V. NOAA Did Not Receive “Best Value”³¹ Due to Poor Contract Negotiations and Lack of Oversight

After a number of catastrophic bearing failures in the rotary TPS units, NOAA began considering possible options open to it to settle contract performance problems. As previously discussed in this report, NOAA began to withhold payment on the rotary units in an effort to enforce the prime’s accountability for satisfactory performance under the contract. In April and July of 2000, the contracting officer issued cure notices³² to the prime, citing its “failure to comply with the contract’s specifications” and requesting an action plan that would correct the non-performing, i.e. defective, TPS rotary units. The prime responded that the specifications were technologically impossible to meet, and based its assertion primarily on a study performed by the Navy on bearing grease life. Discussions were then initiated to determine the course of action that would be in the best interest of the prime and the government.

At the briefing presented to the Assistant Administrator for Weather Services on September 6, 2000, three alternatives were discussed with the goal of moving the program forward. The first alternative was to terminate the contract for default and reprocure, an option deemed potentially costly as well as risky due to the uncertainty surrounding the validity of the contractor’s claim of performance impossibility. The second alternative was to accept the prime’s impossibility argument as well as all additional costs in order to enable the program to continue. The third alternative, described as providing best value for the government, called for a settlement to be negotiated and the program to be restarted. According to the briefing, the third alternative was recommended and would provide a “win/win” situation for both the prime and the government.

The decision to acquire the static TPS alternative from the contractor was formalized with the issuance of modification 0022 to the original contract, which was signed on November 29, 2000. The modification was complex, with 15 separate attachments. It established a new specification for the static TPS units and provided for replacement of the 94 rotary units already installed; pricing for the 56 new TPMS sites; revised maintenance pricing based on the new specifications; and revised data, training, and spares requirements.

We found that the recommended negotiation approach was not used. Instead, NOAA accepted the prime’s contention that the specification was impossible to perform. This decision, in addition to inadequate price analysis and lack of review and oversight, led to poor contract negotiations, which resulted in the government paying for the defective equipment. As shown in table 2, the estimated cost impact of the modification to the contract was an increase of \$4.5 million.

³¹ FAR 2.101 defines best value as “the expected outcome of an acquisition that, in the Government’s estimation, provides the greatest overall benefit in response to the requirement.

³² Cure notices are required by the Federal Acquisition Regulation Part 49.402-3 when termination of the contract for default is being considered. The government may terminate for default when it is determined that the contractor has failed to make progress and as a result performance is endangered.

Table 2: Cost Impact to Original Contract

Prime's Final Proposed Cost for Sites Having Rotary Units	\$5,204,025
Less Estimated Savings Attributed to New TPMS Installations	(726,723)
Total Estimated Additional Cost To NOAA	\$4,477,302

The estimated cost for the retrofit of the completed sites (with the rotary TPS) increased the contract amount by \$5,204,025. This was offset by savings realized primarily as a result of the lower cost for the new static TPS installations, which we estimate to be \$726,723. Our estimate is based on the difference between the estimated cost delineated in the basic contract for the remaining new installations using a rotary TPS and the estimated cost for new installations with the static TPS in modification 0022.³³

A. NOAA Paid for Defective TPS Units

Ninety-four rotary TPS units had been installed by the time modification 0022 was executed. Seventy of these had been fully paid for, and all but 10 percent of the cost of 7 additional units had been paid as well, for a total of roughly \$3.7 million (table 3). In May of 1999, NOAA began withholding payment, as the installed units failed to perform to specification. When the units were shut down on May 9, 2000, NOAA also withheld payment of maintenance fees amounting to \$284,389. Allowable maintenance costs were later calculated in the amount of \$161,145 so that withheld maintenance was reduced to \$123,244. As of November 2000, withheld payment and maintenance fees totaled \$996,499 on 24 installed units (including the 7 units for which there was a 10 percent outstanding balance).

On September 26, 2000, the contracting officer sent a request to the prime for an alternate proposal for resolving the deficiencies of the rotary TPS. A revised TPS specification was attached. On October 6, 2000, the prime submitted a proposal for a solution using its static TPS equipment. It included pricing for the retrofit of the 94 previously installed rotary TPS units in the amount of \$4,207,526, and for 56 new installations in the amount of \$5,318,893, totaling \$9,526,419. According to the proposal, this amount included savings of \$2,593,083, which consisted of \$1,887,179 in credits and discounts relating to the retrofit, and \$705,904 for savings relating to the remaining new installations. The proposal also stipulated that the discounts were conditional upon receiving payment for the outstanding invoices for delivered hardware, services, and data. Offered savings were also to include any credit for removed rotary units; however, there was no supporting documentation detailing this credit. The prime's proposed prices were based on its GSA schedule, and in some cases, prices were lower. For example,

³³ This estimate does not include maintenance, spares, or extended warranties.

placement and installation of the static TPS was offered at a price that was 3 percent below the GSA schedule price.

Table 3: Payments Authorized on Installed TPS Units as of November 2000

	Amount Paid	Amount Withheld
Of the 94 installed:		
70 rotary units	\$ 3,401,585	\$ 0
7 rotary units	306,142	47,156*
17 rotary units	0	826,099
Subtotal	\$ 3,707,727	\$ 873,255
Maintenance	161,145	123,244
Total	\$ 3,868,872	\$ 996,499
*Includes \$13,139 in associated shelter costs.		

On November 2, 2000, the prime submitted a revised proposal. The price for the retrofit of the installed rotary units at 94 sites was increased by \$996,499 to \$5,204,025, and the pricing for the new installations remained the same. The increase resulted from a reduction in the original \$1,887,179 in discounts and credits proposed, as well as an increase in the cost of removing the existing units and changes in the pricing for the shelter modifications. According to the proposal's cover letter, these reduced discounts were based on an offer by NOAA to accept a lower discount in return for the prime's agreeing to waive payment for the delivered equipment and services the prime believed it was due—the \$996,499 that had been previously withheld by NOAA due to out of specification performance of the TPS units and related maintenance (table 4). NOAA officials could not confirm nor did they deny that such an offer was made, however, the proposal was used as the basis for the pricing in the modification.

As shown in table 4, the outcome originally proposed by the prime would have resulted in a cost to NOAA of \$9,072,897 for the rotary TPS units and retrofit with static units of the sites where the rotary units had been installed. This cost was composed of \$4,865,371, the amount invoiced for rotary units prior to modification 0022 and \$4,207,526, the amount included in the initial proposal for static units for the retrofit sites. In the revised proposal, the amount withheld by NOAA for the defective rotary units, \$996,499, was added to the initial proposal in the form of a reduced discount, resulting in a total cost for static units for retrofit sites of \$5,204,025. In the final outcome, the amount paid for defective or removed rotary units in the amount of \$3,868,872, combined with the cost of the static units for retrofit sites in the revised proposal, totaled \$9,072,807. NOAA thus paid for all defective or removed rotary units by accepting the reduced discount—those that initially had been paid for, as well as those for which payment had been withheld.³⁴

³⁴ It should be noted that despite the fact NOAA had paid for the removed rotary units, the prime was given title to them.

Table 4: Proposed and Actual Payment Outcome for Rotary TPS Units and Retrofit

Date	Outcome Originally Proposed by Prime		Actual Outcome	
As of 9/30/00	Amount invoiced for rotary TPS units prior to Mod 0022*	\$4,865,371	Amount invoiced for rotary TPS units prior to Mod 0022*	\$4,865,371
			Amount withheld by NOAA for defective rotary TPS units* and agreed to by contractor in exchange for NOAA's acceptance of reductions in the discount offered in the initial proposal for the retrofit	(996,499)
			Payments authorized by NOAA for rotary TPS units	\$3,868,872
10/6/00	Initial proposal for retrofit including discount	4,207,526	Initial proposal for retrofit including discount	4,207,526
11/2/00			Amount of discount reduced by contractor in exchange for accepting lower payment for on rotary TPS units	996,499
			Revised proposal	\$5,204,025
	Total	\$9,072,897	Total	\$9,072,897
*And related maintenance				

B. Contracting Personnel Did Not Receive Appropriate Review and Oversight

Negotiations for the settlement agreement and the resulting modification were complex and required much analysis. A lack of appropriate review and oversight of the negotiation process and of the subsequent issuance of the modification contributed to the poor negotiations that resulted in NOAA not receiving the best value for the static TPS units.

Although a contract specialist is usually assigned to perform the daily work pertaining to a contract or contract action, the contracting officer is ultimately responsible for performing all necessary actions for effective contracting as well as for ensuring compliance with the terms of

the contract and safeguarding the interests of the United States in its contractual relationships.³⁵ Also, according to FAR 14.405(a), the “contracting officer is responsible for exercising the requisite judgment needed to reach negotiated settlement with the offeror and is solely responsible for the final price agreement.” The contracting officer should request assistance and advice from individuals specializing in contract law, audit, and engineering as needed. Requests for reviews and approvals from technical and contracting officials, review boards and legal counsel should be made and responded to in writing.

Because the contracting officer has ultimate responsibility, it is incumbent upon this official to thoroughly review all solicitations, contracts, and modifications before signing them. In addition to this review, an independent review and approval procedure or body, such as a contract review board, would also help ensure that all laws, policies, procedures, and sound business practices are followed and that contractual documents appropriately reflect what all parties agreed to. This review would help the government ensure that concerns and deficiencies are identified prior to award of the contract or modification, so that appropriate action can be taken to address any concerns or deficiencies. Prior to September 2000, an independent quality assurance review procedure existed for significant procurement actions, as specified in NOAA Administrative Order 208-5 *Review and Approval of Proposed Contract Awards*. Implemented by Policy and Procedure Memorandum 92-04, dated August 8, 1996, it requires modifications exceeding \$5 million be reviewed by a contract review board, and approval by the Head of the Contracting Office (HCO) for actions over \$10,000,000. It also provides for contract review board review of any significant action under the dollar thresholds. Although these procedures have not been rescinded, we were told that NOAA Acquisition had not used them since October 2000. Prior to that, the procedures had been used sporadically.

A GS-12 contract specialist, under the supervision of a senior contracting officer, handled the administration of the TPMS contract. Based on our review, it appears that the contracting officer responsible for the TPMS acquisition did not adequately review documentation and exercise appropriate oversight, particularly for the issuance of modification 0022. Though his signature was on the price negotiation memorandum for the modification, as well as on the modification itself, he could offer little clarification on the information contained in the document. He informed us that his primary role in the negotiation was that of a reviewer and that the TPMS contract was not the only contract for which he was responsible. The contracting officer could not provide an explanation regarding the prime’s statement in the revised proposal that NOAA had offered to accept a reduced discount. In addition, there was scant evidence to support any independent³⁶ review of either the negotiation settlement or the resulting modification, which may have identified problems, deficiencies, or weaknesses. It is not clear what review and approval procedures were in place at the time the modification was issued. We were told that the HCO reviewed the modification, but the contract file contains no documentation to support such action. According to the contracting officer and OGC, legal review was obtained, but we found no written evidence documenting this review.

³⁵ *The Commerce Acquisition Manual, 1301.6, Section 3* specifies the roles and responsibilities of Contracting Officers. (Also, see Federal Acquisition Regulation 1.602-2, *Responsibilities*.)

³⁶ An independent review is one in which the individuals participating in the review of an action have not been involved in the processing of that action.

C. Price Analysis of Proposals Was Inadequate

Failure to review the proposals and conduct an adequate price analysis may have contributed to the poor negotiations and the subsequent decision to accept the prime's revised proposal. Our review of the contract files did not uncover documentation to support any kind of price analysis of the original and revised proposals. FAR 15.404-1(a)(1) states that the contracting officer is responsible for evaluating the reasonableness of proposed prices. Without adequate analysis, it is difficult to establish a negotiation position and determine whether proposed prices are fair and reasonable. Although a price negotiation memorandum was prepared and signed, it included no discussion of the results of the price analysis, or of the negotiation objectives or lack thereof.

The FAR defines price analysis as the "process of examining and evaluating a proposed price without evaluating its separate cost elements and proposed profit." Such analysis helps the contracting officer develop a negotiation position that will result in a fair and reasonable price, both for the government and the offeror (or contractor, in the case of modifications to a current contract).³⁷ Various price analysis techniques and procedures may be used, including comparison with competitive published price lists and analysis of the pricing information provided by the prime. There was no documentation in the contract files indicating that such techniques were used for this modification.

The contracting officer did not question the reduction of previously offered discounts in the revised proposals; in fact, during our interview he stated he was unaware that the revised proposal contained a reduced discount. The contracting officer also did not question the lack of competitive quotes for the static TPS unit offered by the prime. The prime was awarded this contract as an integrator responsible for acquiring the parts and services needed to assemble the TPMS. As such, the prime was responsible for ensuring that the services and parts obtained via subcontractors constituted the best deal for the government. The prime, instead, had proposed its static units and provided no evidence that it was offering a solution that constituted the best value. There were other static units available, including units that used the newer technology discussed in finding III (pages 20-25). Replacing the TPS was the sole reason for the negotiated settlement, and the contracting officer should have assessed whether the price proposed for the unit was fair and reasonable based on adequate price analysis, and whether the alternative proposed offered the best value to the government. No such assessment was conducted.

D. Details of the Settlement Negotiation Are Unclear

How the actual settlement was defined and negotiated is unclear. There is little documentation to support the actual negotiation of the agreement and the resulting modification. Although a price negotiation memorandum was prepared and signed on November 17, 2000, it does not provide much information on the actual results of the negotiation or the events leading up to it. Moreover, the contracting and program officials involved provided us minimal clarification. A memorandum to the file signed by the contracting officer and reviewed by OGC attempts to justify the negotiated settlement and the modification; however, many questions remain unanswered.

³⁷ Federal Acquisition Regulation, Part 15.405, *Price Analysis*.

As noted, on September 26, 2000, the contracting officer sent a letter to the prime requesting a change proposal to “remedy the deficiencies that exist with the current TPS.” A revised TPS specification was enclosed, and a proposal was requested by October 11, 2000. The prime submitted a proposal, dated October 6, 2000, that, as previously discussed in this report, included savings of \$2,593,083 (\$1,887,179 in credits and discounts relating to the retrofit, and \$705,904 for savings relating to the remaining new installations). According to the second proposal, which was submitted November 2, 2000, NOAA had offered to accept a reduced discount in return for the prime waiving the withheld payments of \$996,499. Neither our review of the contract file nor our discussions with cognizant program and contracting officials clarifies events or discussions that took place between the time of the first and second proposals that would have led to NOAA’s accepting the increased price. In fact, the officials we spoke to were unaware that the second proposal contained an increase and that the prime had indicated that the proposal was submitted in response to an offer made by NOAA. This lack of awareness is difficult to understand, given the fact that the modification clearly incorporates in total the prices in the revised proposal, and that the modification was reviewed by OGC and signed by the contracting officer.

The contracting officer told us he did not negotiate the settlement but acted only as a reviewer, and no official we interviewed was able to identify who actually negotiated the settlement. FAR Part 15.406-3 requires that elements of the negotiated agreement be documented and include the prime’s proposed prices, the government’s negotiation objective, and the negotiated price. Thus, a negotiation position should have been developed, incorporating price proposal analysis, and the results of all discussions should have been documented. The price negotiation memorandum lists several individuals who “participated in the respective discussion sessions that formed the basis of the technical and cost content of the changes associated with” the modification, including the contracting officer, the COTR, the director of the NWS Office of Operational Systems and other senior officials. However, no record exists of any of the discussions held pertaining to the October 6 and November 2 proposals.

According to the contracting officer, after receipt of the October 6 proposal, NOAA was unhappy with the offer and with the fact that the reduction from the GSA schedule and any consideration for the failed units had been proposed together, instead of priced separately, and contracting and program personnel met to determine the next step. At that meeting, it was decided that someone needed to meet with the prime’s management to see whether negotiation was possible. As a result, a management official in NWS’ Office of Operational Systems met with an individual from the prime’s management staff, one on one, on or around October 11, 2000. According to this official, numbers were not discussed, as he did not have contracting authority, and his primary purpose for attending the meeting was to get the TPMS program restarted. On November 2, 2000, the revised proposal with the reduced discount was received.

The settlement agreement detailed in modification 0022 exactly matches the offer made by the prime in the revised proposal, and we were unable to find any evidence that meaningful discussions occurred. The contract files contained a spreadsheet that detailed, on a task order basis, the difference between the October 10 and November 2 proposals and reflected that the total amount of the increase matched the withheld payments. However, the price negotiation memorandum does not refer to this information and does not provide details of any negotiations

or any explanation of the acceptance of the reduced discount. Moreover, the memorandum does not provide the government's negotiation position or the outcome. Rather, it contains a high-level discussion devoid of detail to support the cost and price discussions. There is some discussion on payments that had been withheld on the 24 defective units, as well as the prorated maintenance support. However, the impact of the revised proposal and the higher prices as a result of the reduced discounts is not analyzed.

OGC, after reviewing the price negotiation memorandum, requested additional justification for proceeding with the modification. A memorandum to the file was prepared, which was signed by the contracting officer on November 29, 2000, and sent to OGC, who verbally concurred with the content. This memo states that as a result of "hard-line" negotiations conducted by the government, payment on the 24 units and certain maintenance would not be made. It did not address the fact that NOAA ended up paying a higher price for the retrofit of the installed TPS units, thereby eliminating in total the impact of the stated savings.

E. NOAA Failed to Adequately Address Prime Contractor's Contention That the Specification Was Impossible to Perform

In its response to the second cure notice, the prime asserted that the specification for the rotary TPS was technologically impossible to perform. To support its position, it identified a study by the Navy on grease life,³⁸ which was purported to demonstrate that available greases could not perform for the required 5 years without breaking down. Although the applicability of the Navy study was tenuous and its results unpersuasive as applied to the rotary TPS, NOAA allowed its negotiating position to be weakened by accepting the prime's assertion.

The study evaluated the performance of 11 greases for the purpose of improving the quiet life of bearings used in submarine machinery. In its response to the cure notice, the prime argued that the Navy study demonstrated that the requirement for a permanently sealed, lubricated bearing on the NEXRAD rotary TPS was technologically impossible. We find the prime's position unconvincing for the following reasons:

- The greases and bearings tested were different from those used on the rotary TPS.
- The report considered the operating conditions imposed by the grease testing machines used in the study to be rigorous, but no comparison was made between these conditions and the conditions of the TPS.
- The grease described by the prime as having a mean grease life of 21,575 hours actually had a longer life because one of the four bearings tested with this grease had not failed when the test period ended.

³⁸ Wong, J., Carderock Division, Naval Surface Warfare Center, September 20, 1995. *Evaluation of Commercial Greases for Potential Use as Improved Quiet Ball Bearing Lubricants for Submarine Auxiliary Machinery*, Bethesda, MD: United States Navy.

- Bearings tested with one of the other greases in the study experienced no failures before the end of the test period. At that point, these bearings had operated for an average of 29,673 hours.

Moreover, before contract award, the capability of the rotary TPS to satisfy the reliability requirement had to be demonstrated in factory testing. To do so, the subcontractor identified one of its older model rotary TPS units that had been operating for 9 years and several that had operated for more than 6 years without bearing maintenance. This information suggests that the specification was not technologically impossible.

Despite the inconclusiveness of the grease study, NOAA formally addressed the impossibility claim only once—in the contracting officer’s August 15, 2000, letter to the prime discussing the latter’s response to the second cure notice in which he states that the government is “not convinced the specifications cannot be met.” In contrast, ROC engineers’ review of the response indicated that they supported the prime’s claim; however, we found no documented analysis to support their position. NOAA’s ultimate acceptance substantially weakened its position in the negotiation of the settlement agreement detailed in modification 0022. In the November 29, 2000, memorandum to the file providing justification for the modification, the primary reasons given to accept the prime’s proposal for its static TPS were the prime’s contention of impossibility of performance and NOAA’s expectation that the static TPS performance would exceed specifications.

NOAA Acquisition’s November 29 memorandum contends—with OGC agreement—that the government could be construed legally to have had superior knowledge (i.e., that NOAA should have known the specification was impossible to perform) because it could have had access to the Navy study. According to the contracting officer, this “superior knowledge” could have made it difficult to argue that the specifications could be successfully met. We found no evidence to suggest that NOAA had knowledge of the study. Moreover, in government contract law, knowledge of one government agency will not be attributed to another government agency unless there is a logical and meaningful connection between the two.³⁹ Furthermore, given the fact that the Navy report did not apply to the TPS situation and therefore did not support the prime’s impossibility of performance argument, government knowledge of the report is irrelevant.

Conclusion

Negotiation is a process of give and take, where the outcome should result in mutual satisfaction. Negotiation is not successful when one side is perceived as having done significantly better at the expense of the other. We believe this to be the case in the negotiation of the settlement agreement. Inadequate price analysis, lack of appropriate review and oversight, and unclear and undocumented negotiation strategies contributed to this outcome. By offering to accept the reduced discount, NOAA paid for all the defective static units and associated maintenance, and thus failed in its responsibility for ensuring the government receives the best value for negotiated acquisitions.

³⁹ John Cibinic and Ralph C. Nash; *Administration of Government Contracts, Third Edition*; (Washington, D.C.: The George Washington University, 1995), pgs. 259-260.

Recommendations

The Director of NOAA's Acquisition and Grants Office and Assistant Administrator for Weather Services should take the necessary actions to ensure that:

1. Quality assurance and review procedures for significant procurement actions are established and implemented that clearly stipulate roles and responsibilities, and assure appropriate oversight and accountability.
2. Contracting personnel receive the appropriate training in cost and price analysis and negotiation techniques.
3. To enhance the government's negotiating position, contracting officers seek and receive comprehensive explanations from technical personnel regarding applicable technical issues.

Synopsis of NOAA's Response

NOAA disagreed with our statement that the recommended negotiation approach had not been used, and stated that the best value approach had been based on the prime's willingness to accept some responsibility for performance problems despite its contention that specifications were impossible to perform. NOAA also pointed out that it considers there to be a substantial difference between acceptance of the impossibility of performance argument and the decision not to pursue the termination for default because of concern that the government would have difficulty in defending such an action. NOAA also discussed that the alternative of termination for convenience could have exposed NOAA to a substantial claim.

In our draft report, we indicated that price analysis should have identified proposed installation costs for static units that had been purchased for testing under separate purchase orders, and for which installation had been included. NOAA pointed out that original installation had been temporary, and the proposed installation costs were for permanent installation.

NOAA stated that the contract specialist negotiated the agreement for the settlement, with the assistance of the OOS lead engineer and the COTR. The departure of the contract specialist shortly before award of the modification severely hampered the efforts of the contracting officer and others as they completed the modification.

NOAA's response also stated that the memorandum providing additional justification for modification 0022 was signed on November 29, 2000, not November 17, 2000.

OIG Comments

We do not believe that NOAA obtained the best value in the negotiation of modification 0022. It is difficult to conclude that the prime accepted much responsibility, if any, for the performance problems, as NOAA ended up paying for all the defective rotary units, as we discuss further in the report. The approach used was more in line with the second alternative presented at the

September 6, 2000, briefing to the Assistant Administrator for Weather Services, which was to accept the prime's impossibility argument and to pay the additional costs. While the decision not to terminate may have been justified, an adequate rationale was never documented. Also, clearly some effort should have been made to negotiate and obtain a settlement that was fair and equitable to both parties, not just the prime contractor.

NOAA's statement that the original installation of static units for testing had been temporary, and the proposed installation costs were for permanent installation is new information that was not made available to us at the time of our review. As a result, we have deleted the discussion on the installation costs.

During the course of our review, we conducted several interviews and at no time were we told that the contract specialist negotiated the settlement agreement. One scenario presented to us had several individuals involved; another alleged a senior NWS official negotiated the final agreement. While contract documentation supports NOAA's statement that the contract specialist conducted analysis and worked with the individuals mentioned in NOAA's response, it is not clear who made the alleged offer to accept the reduced discount or the prices detailed in the November 2, 2000, proposal. Also, the fact that the contracting officer had such difficulty completing the modification at the time of the contract specialist's departure supports our contention there was a lack of oversight during the negotiation of modification 0022.

Where appropriate, we changed our report to indicate that the memorandum providing additional justification for modification 0022 was signed on November 29, 2000.

VI. Reviews of Specifications and Other Technical Information Must Be Improved

The vibration consultant concluded that the fundamental source of the bearing problem was insufficient lubrication and excessive vibration. We found that several TPS requirements that may not have been needed contributed to the technical and contractual issues surrounding the bearings. Improved review and oversight of specifications and other technical information is needed to avoid similar problems on future acquisitions of complex items.

Bearing Design

According to the FAR, an agency's needs should be stated as performance requirements rather than design requirements whenever feasible. However, the TPS requirement for sealed, permanently lubricated bearings was a design requirement, which the prime used to make the argument that the specification was impossible to perform. The requirement—aimed at making the bearings maintenance free—was unnecessary because the specification also required that preventive maintenance not exceed 1 hour per year, a provision that would achieve the same objective. Combined with the specification for reliability of 43,800 hours MTBF, the bearings were required to have a maintenance-free 5-year service life without the need to stipulate their design. However, because aspects of the bearing design were prescribed, a change to the specification was needed to allow the subcontractor's proposed relubrication system to be implemented. This unnecessary requirement thus allowed the impossibility argument to be raised and the relubrication system to be offered as a cost option.⁴⁰

Vibration

The vibration consultant recommended replacing the aluminum motor end bell with an iron end bell to reduce vibration. According to the consultant's report, the primary benefit of iron was increased stiffness, with increased weight being a secondary benefit in reducing vibration. Although the subcontractor used ductile iron in the commercial version of its rotary TPS, aluminum had been substituted specifically for NWS to satisfy the weight limit contained in the TPS specification, a requirement that appears to have been unnecessary.

The TPS specification originally included requirements for steel frame cabinets and a weight limit of 5,000 pounds, requirements later changed to "heavy-duty frame, metal cabinets" and a weight limit of 7,500 pounds. When NWS learned that the subcontractor was considering using an aluminum frame to meet the weight limit, discussions ensued as to the desirability of aluminum because of its greater susceptibility to expansion and fatigue. Although the choice of aluminum versus ductile iron was debated within NWS, we found no evidence that the weight requirement itself was questioned even though it was increased by 50 percent to accommodate the rotary TPS. During our fieldwork, we received various rationales for having a weight limit from NWS officials. They included that the weight limit was needed because some sites were in remote locations and a forklift could not be used to move the TPS in such locations and because the TPS might be too heavy for some roads in remote locations.

⁴⁰ The rotary TPS bearings were actually shielded, not sealed, but were considered by the manufacturer to be permanently lubricated, non-maintenance items.

These explanations are not supported by the TPMS specifications. The TPS specification states that the TPS must be moveable by forklift and does not identify any locations where specialized handling is required. The shelter specification requires sufficient floor loading capability to support the TPS and all ancillary equipment, and it could have been left to the prime to ensure that the shelter floor could support the TPS that it selected. Since the TPS specification had a requirement that size, weight, and physical characteristics must not exceed the limits imposed for commercial equipment by common surface, air, or sea carrier, there was no need to specify a weight limit to accommodate roads. Instead, it would have been prudent to allow the contractor to take responsibility for dealing with transportability issues.

A great deal of debate surrounded the weight requirement and the use of aluminum to meet it. E-mails contained in the contracting officer's files indicate that that NWS engineers ultimately assumed that aluminum would have no effect on the operation of the TPS and the subcontractor verbally assured NWS that this assumption was valid. However, this substitution was a significant departure from the subcontractor's commercial practice, but analysis was not performed to determine whether aluminum would have any negative effects. The weight requirement should have been validated and if found to be needed, NWS should have been proactive in ensuring that an analysis of the potential effects of using aluminum was performed before agreeing to this approach. Since the subcontractor used aluminum to satisfy the TPS specification and retrofitting the TPS with a ductile iron end bell required a specification change to eliminate or increase the weight limit, the retrofit was offered at an additional cost to the government.

Improved integration of technical, contractual, and legal issues needed

Because specifications become legal requirements when they are incorporated into contracts, all requirements must be necessary and expressed in a way that will allow them to withstand contractual and legal challenges. Thus, it is essential that technical, contractual, and legal personnel provide an integrated review of specifications and statements of work that comprehensively addresses all technical, contractual, and legal concerns before a solicitation is issued, particularly for the acquisition of complex items. Specification and statement of work reviews should ensure that these documents incorporate only validated requirements and that requirements are clear, appropriately stated, and expressed in performance terms whenever feasible. When complex items are to be acquired, issuing a draft solicitation, including the specifications and statement of work, for industry review and comment will also help identify issues and needed changes before contract award and thus reduce problems during contract performance.

Well coordinated reviews are also needed after contract award. For example, a more thorough review of the Navy grease life study by NWS technical personnel and better communication of its contents to the contracting officer and OGC would have strengthened NOAA's negotiating position on modification 0022.

Recommendations

In future NWS acquisitions, the Assistant Administrator for Weather Services and the Director of NOAA's Acquisitions and Grants Office should take the necessary actions to ensure that:

1. NWS' needs are stated in specifications as performance requirements rather than design requirements whenever feasible;
2. Specifications receive integrated technical, contractual, and legal review; and
3. Draft solicitations are issued for industry review and comment when appropriate.

Synopsis of NOAA's Response

NOAA pointed out that the independent consultant found the vibration was caused by the unit being resonant at 120 Hz and recommended the iron end bell to change the unit's resonant frequency.

OIG Comment

We addressed this issue in our discussion of NOAA's comments on finding II (page 17).

VII. Purchase of the Engine Generators Was Outside the Scope of the Contract

In June and October 2001, engine generator upgrades were acquired at various NEXRAD sites through modifications to the TPMS contract. These modifications were outside the scope of the contract. The total estimated cost associated with the generator upgrades is \$624,068.

On June 7, 2001, modification 0026 to the TPMS contract was issued for engine generator upgrades for five TPS-only sites. A memorandum to the contract file signed by the contracting officer states that the reason for these upgrades was that the sites were high-altitude snow sites and required a larger engine generator. A subsequent modification was issued on October 24, 2001, for two upgrades to engine generators in Yuma, Arizona, and Norman, Oklahoma. According to a memorandum prepared by the contracting officer, the engine generators were needed to accommodate the larger air conditioning units, as well as the fact that sites were at capacity and could not support additional power loads. This was a concern, as NWS anticipated load increases in the future.

Under government contract law, work lies within the scope of the contract if it can be reasonably determined to be in agreement with what had been contemplated by the parties at the time of contract award, and was essentially the same work.⁴¹ However, the acquisition of the generators was outside the scope of the TPMS contract because the engine generators are not part of the specifications for the TPMS, and the replacement of the generators had not been deemed to be an essential part of fulfilling the contract requirements. The contracting officer justified the acquisition of the generators under the TPMS contract, stating that the use of the existing generators had created an “impossibility for the TPS to operate.” However, NWS engineers and the prime believed it to be outside the scope. In response to concerns expressed early in the project by personnel from the NWS Southern and Western Regional Offices regarding the TPS and the capacity of the generators, the ROC stated, “the TPMS project was not intended nor funded as a replacement project for existing generators. The specification required the prime to provide a system that could operate within the constraints of the generator...” A May 13, 1998, Project Management Status Report submitted by the prime indicated that the capacity of the existing electrical service including the engine generator systems had been questioned, and that both the prime and NWS agree that replacing them lies outside the scope of the contract. The issuance of these two modifications as changes to the TPMS contract may have prohibited the opportunity for competition and possible savings. We found no evidence in the contract file that OGC advice was obtained.

Recommendation

In future NWS acquisitions, the Assistant Administrator for Weather Services and the Director of NOAA’s Acquisition and Grants Office should ensure that there is adequate review and oversight of proposed modifications to verify and document that they fall within the scope of the contract they are modifying.

⁴¹ *Administration of Government Contracts, Third Edition*; pgs. 385-386.

Synopsis of NOAA's Response

According to NOAA, the contracting officer determined that the acquisition of the engine generators was within the scope of the contract and neither the ROC nor the prime contractor expressed any concerns or objections in discussing the proposed change. NOAA also makes reference to a discussion between an OOS engineer, a contracting officer, and OGC in which it was agreed that the change of the engine generators at a few sites was within scope. In its response, NOAA stated that the need for an engine generator upgrade for the high-altitude snow sites had been verified by rotary acceptance testing at Grand Junction, Colorado. NOAA also stated that the Yuma site had power loads that were not normal at the average NEXRAD sites and would have needed a power upgrade for either a rotary or a static unit.

OIG Comments

It is not surprising that neither the ROC engineer nor the prime contractor expressed any objection to issuing the change request, given that both parties would benefit from such a modification—a quick solution to the power problem and additional business for the prime. Also, the fact that the contracting officer, in making his determination, was not aware of earlier decisions that the engine generator upgrades were considered to be outside the scope of the contracts reinforces our belief that improved communication between program and contracting staff is imperative, as well as our recommendation for finding V (page 40) that contracting officers receive comprehensive explanations from technical personnel. We were not made aware of the discussion between the OOS engineer, contracting officer, and OGC during any of our interviews. As NOAA stated in its response, there was no supporting documentation for any such meeting. It is important that review and oversight of such contract actions be appropriately documented.

Where appropriate, we have modified our discussion on the reasons given for the replacement of the engine generators to reflect the source of our information, contract file documentation. We have also deleted the reference to the rotary TPS, as it pertains to the Yuma, Arizona, site. We are not questioning the need for larger engine generators at the five high-altitude sites, Yuma, or Norman, Oklahoma, just the method of acquiring them.

VIII. Conclusion

We found that NWS paid for defective equipment and that contract modification 0022 was negotiated and executed without proper review and oversight. Although the original decision to use rotary TPS technology was well supported, the unit acquired was immature and unproven and experienced severe problems. Once the rotary units began to fail, NOAA mishandled the process of addressing the problems and selecting an alternative, with the result that it is now completing the acquisition of a static TPS that may not be the most appropriate choice for NEXRAD. Significant causes of the issues discussed in this report include:

- failure to appropriately consider technical alternatives;
- over reliance on contractor-provided technical information for decision-making;
- poor contract negotiations;
- unclear accountability, inadequate communications, and insufficient oversight of technical and contractual personnel and decisions; and
- inadequate coordination among technical, contractual, and legal personnel for review of technical information.

To prevent these types of management, technical, and contractual problems from occurring on future acquisitions, NWS and NOAA Acquisition need to perform their own evaluations to determine any additional factors that may have caused the problems on the TPS acquisition and identify improvements that are required in policies, procedures, and oversight. They also need to determine whether any personnel involved in the TPS acquisition require additional training or closer supervision.

Recommendation

The Under Secretary for Oceans and Atmosphere should ensure that the Assistant Administrator for Weather Services and the Director of NOAA's Acquisitions and Grants Office take the following actions:

1. Undertake a review of their acquisition policies, procedures, and oversight to identify actions needed to prevent similar problems from occurring on other acquisitions. The results of this review should be documented and should include a time line for implementing actions to be taken.
2. Determine whether any personnel involved in the TPS acquisition require additional training or closer supervision and provide these measures as appropriate.

Appendix A. Acronyms

AFB	Air Force Base
ASR	Airport Surveillance Radar
CBD	Commerce Business Daily
COTR	Contracting Officer's Technical Representative
COTS	Commercial-off-the-shelf
DOD	Department of Defense
DOT	Department of Transportation
FAA	Federal Aviation Administration
FAR	Federal Acquisition Regulation
HCO	Head of the Contracting Office
IEEE	Institute of Electrical and Electronics Engineers
IGBT	Insulated Gate Bipolar Transistor
ISO	International Standards Organization
KVA	One Thousand Volt-Amperes
KW	One Thousand Watts
MTBF	Mean Time Between Failure
NEXRAD	Next Generation Weather Radar
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
OGC	Office of General Counsel
OOS	Office of Operational System
OSF	Operational Support Facility
RDA	Radar Data Acquisition
SCR	Silicon Controlled Rectifier
TDWR	Terminal Doppler Weather Radar
THD	Total Harmonic Distortion
TPMS	Transition Power Maintenance Shelter
TPS	Transition Power Source
UPS	Uninterruptible Power System
VECP	Value Engineering Change Proposal
WSR-88D	Weather Surveillance Radar - 1988 Doppler



Appendix B

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NOAA FINANCE AND ADMINISTRATION
CHIEF FINANCIAL OFFICER/CHIEF ADMINISTRATIVE OFFICER

AUG 15 2003

MEMORANDUM FOR: Johnnie E. Frazier
Inspector General

FROM: *for* Helen Hurcombe *John Schauer*
Acting Chief Financial Officer/
Chief Administrative Officer

SUBJECT: *Acquisition of NEXRAD Transition Power Source Marred by
Management, Technical, and Contractual Problems*
Draft Inspection Report No. OSE-15676 / July 2003

Attached is the National Oceanic and Atmospheric Administration's response to the Office of Inspector General's draft inspection report on the NEXRAD Transition Power Source acquisition. The response has been prepared in accordance with Department Administrative Order 213-3.

We appreciate the opportunity to respond to your draft inspection report.

Attachment



**National Oceanic and Atmospheric Administration
Response to Office of the Inspector General (OIG)
Draft Report No. OSE-15676/July 2003**

**Acquisition of NEXRAD Transition Power Source Marred
by Management, Technical, and Contractual Problems**

The Transition Power Maintenance System (TPMS) acquisition was a challenging project. Early in the deployment, the rotary Transition Power Source (TPS) experienced electronics reliability problems. Meetings with the prime and subcontractors to address these problems began in May 1998, three months after the first installation. In May 1998, problems were documented regarding step load response and other power output issues. A short time later, additional rotary output issues were identified, along with reliability issues, but were never completely corrected. National Oceanic and Atmospheric Administration (NOAA) staff members worked with the prime and subcontractors to resolve these reliability and performance issues on a daily basis via technical interchange meetings, program management reviews, daily telephone discussions and weekly status meetings. Two catastrophic bearing failures in October 1999 were "the straw that broke the camel's back." The frustration mentioned on page 10 of the report is understated; however, frustration was not with bearing issues alone, it was caused by a lack of confidence in the subcontractor to effect necessary fixes using established system engineering, manufacturing, and quality control practices--their track record was not encouraging.

In spring 2000, NOAA was faced with the following situation: two years of continuous, unresolved performance and reliability problems, TPS units turned off due to catastrophic bearing failures leaving radars unprotected, and a costly, time-consuming proposal for fixing the rotary TPS units. The question became, "How long should NOAA continue to 'throw good money after bad?'" This was a tough judgement call for NOAA managers. At the time the decision was made, none of the permanent fixes to the rotary TPS had been demonstrated by the manufacturer. While some of these fixes were later installed in much larger FAA 201-F TPS units, it was unclear if similar fixes would be effective in smaller NOAA 201-N TPS units. NOAA managers noted the FAA had switched from a rotary TPS to a static TPS solution for their Terminal Doppler Weather Radar (TDWR) system. The prime contractor's proposal to replace rotary TPS with static TPS units was judged to offer the best value business decision for NWS under the circumstances.

The last TPMS unit will be installed in September 2003, thus completing the program. The static TPS units have performed well with the entire NEXRAD system. Radars run through power anomalies without any computer restarts or loss in data, radar availability is above the 96 percent standard, parts usage is decreasing, and run time on generators is significantly reduced since they are no longer switched on manually with the threat of severe weather.

NOAA agrees with the recommendations in the draft report. The recommendations represent good business practice; to implement the

recommendations NOAA will review, implement, and monitor improved acquisition processes and training processes (more details are contained in the "Response to the OIG Recommendations" section). However, NOAA suggests a number of changes in the factual information included in the draft report, as detailed below.

Recommended Changes for Factual Information:

Page i, paragraph 6:

Change the first two sentences to read: "The ROC reported that radar component failures and maintenance costs were significantly reduced at sites with poor power, approaching \$2,300 per site per month at worst commercial power sites (less savings at sites where commercial power is good). The first two rotary units installed had performance and reliability problems as documented in a May 13, 1998, Project Management Status Report documenting a TIM with the prime contractor. As installation progressed, TPS units continued to experience performance and reliability problems."

REASON FOR CHANGE: The prime contractor was notified of concerns about performance and reliability with the first two rotary TPS units as early as May 1998.

Page ii, first partial paragraph on the page:

Add to the end of the sentence that starts: "On May 9, 2000 the ROC directed that" add the following: "and to protect Government contract rights." Also, add the following sentence in front of the last sentence in the paragraph: "The interim solutions, when tested, failed to correct the problems and were never implemented in the field."

REASON FOR CHANGE: To avoid further catastrophic failures and to not limit Government rights for future contract decisions. Further, ROC engineers witnessed tests of the interim solutions, antihunt software, and vibration sensors in May 2000. Neither of the interim fixes corrected the problems with the rotary TPS.

Page iii, first full paragraph:

Change the paragraph to read: "The change to switch to the prime's static TPS was made after the interim fixes recommended by the subcontractor were tested and proven to be ineffective. In the meantime, the subcontractor provided a different model rotary TPS to the FAA. At the time NOAA was making the final decision to change to a static TPS, the FAA units were undergoing factory test. ROC engineers noted these units passed factory testing, as had the NOAA rotary TPS units, without the interim or permanent modifications recommended by the manufacturer. The FAA rotary units were installed and accepted on an interim basis the same month contract modification 0022 was issued. The two units were finally accepted by the FAA four

and seven months later. The FAA also was installing a different manufacturer's static TPS with newer technology that might be more suitable for NEXRAD. ROC engineers concluded this new technology might be more suitable, but acquisition costs would be higher than the prime's TPS units. In addition, the implementation of the new technology TPS units would take longer than the prime contractor's unit. Any delays in replacing defective rotary TPS units meant the Government would continue to pay higher site maintenance and fuel costs, lose critical severe weather data because of computer restarts and wear out engine generators by having to run them each time a thunder storm appeared."

REASON FOR CHANGE: The current paragraph is incorrect that fixes proposed by the rotary manufacturer were not tested and that progress on fixes was not monitored. The incorrect assumption is made that the FAA units tested in the factory in mid-July had a regreaser unit and new bearings installed. ROC engineers present in the factory during these tests reported the units were shipped without these fixes. ROC engineers did investigate the new technology TPS, including the Mitsubishi unit used by the FAA on the TDWR. The new technology units were not attractive because the prime contractor's unit met NEXRAD requirements, had a lower acquisition cost and could be retrofit into the NEXRAD network faster than the new technology units.

Page iii, first full paragraph:

Before the sentence that reads: "The first two catastrophic" add the following: "The prime contractor was notified about problems with performance and reliability in May, 1998."

REASON FOR CHANGE: Accuracy; the May 13, 1998 Project Management Status Report documented a TIM in which the Government and the prime discussed concerns with the rotary TPS three months after the first two units were installed.

Page iv, first partial paragraph:

Delete the following: "Without ever evaluating static units from other manufacturers" Delete the last sentence from the paragraph.

REASON FOR CHANGE: ROC engineers did evaluate static TPS units from other manufacturers. At one time, NOAA intended to purchase a unit for further testing, but decided not to do so when it was determined such a test could be interpreted as directing a technical solution on the prime contractor. It is incorrect the FAA TPS units completed successful factory testing with the modifications installed. ROC engineers were in the factory in mid July 2000 and determined the FAA units, which had passed factory testing and were packed for shipment, did not have the modifications installed at that time. The units were accepted on an interim basis on site in November 2000, the same month NOAA issued modification 0022 for the static units. The first two FAA TPS units were not finally accepted until March and June 2001.

Waiting for final acceptance of the FAA systems would have caused a significant delay in retrofitting the NOAA NEXRAD sites. A delay meant the Government would incur higher maintenance costs, estimated to approach \$2,300 per month per site at NEXRAD sites not protected by a rotary or static TPS where commercial power was poor. In addition NWS radars would continue to lose critical severe weather data because of computer restarts caused by commercial power anomalies and experience increased wear on engine generators.

Page iv, second full paragraph:

In the first sentence following "engine generator . . ." add "and noise induced in the signal processor were the key reasons for the ROC" Also, at the beginning of the penultimate sentence add: "Although the static TPS purchased by NOAA meets NOAA requirements, it does not use newer technology and may be"

REASON FOR CHANGE: Accuracy; the engine generator was not the only reason rotary technology initially was considered suitable. Also, the static TPS provided by the prime meets requirements, even though there may be a superior, more costly static TPS technology available.

Page v, first partial paragraph:

Delete the sentence that starts: "However, the NWS did not evaluate . . ." and change the rest of the paragraph to read: "Other technology TPS hardware was evaluated, but not tested on a NEXRAD radar since such a test could be interpreted as directing a contract solution. The NWS relaxed the reflected current THD from a maximum of 5 percent to an average of 20 percent in contract modification 0022. The prime's unit was thus able to meet the revised specification. The units have had 1.9 million hours of operation as of June 2003 with no detected deterioration of engine generators from reflected THD."

REASON FOR CHANGE: As noted above, the NWS did evaluate the Mitsubishi TPS, but it was not tested on a NEXRAD. The previous wording of the report mixes reflected THD with output THD. Reflected THD impacts the engine generator while output THD impacts the radar equipment being powered/protected by the TPS. Output THD was not an issue and the prime's static TPS had a better output THD than the rotary TPS.

Page v, first complete paragraph:

Add the following after the third sentence: "Comparison of reliability data between the two units is difficult because: (1) TDWR systems are installed in urban environments with much better commercial power than the NEXRAD units typically installed in rural environments with poor power causing degradation to TPS reliability, and (2) the NWS tests the power subsystem every week per IEEE recommendations, while the FAA does not do so. This means the NWS discovers and reports TPS failures while the FAA must sustain a

failure in actual operation in order to report a failure of their TPS units." Delete the sentence that starts: "Because NOAA did not assess the FAA's experience"

REASON FOR CHANGE: Data indicates an apparent difference between TDWR and NEXRAD TPS reliability. Some of the differences in reliability are attributable to differences in commercial power quality and the fact that the NWS tests the TPS weekly for failures while the FAA only reports failures discovered during actual operation of the TPS. This means NWS tends to report more failures than the FAA, giving the appearance of lower reliability.

Page vi, second full paragraph:

Delete the sentence that starts: "NOAA accepted this proposal"

REASON FOR CHANGE: The alternative, termination for convenience, whether by choice or through conversion through legal action of a default termination, would expose NOAA to a substantial claim and, at some point, require additional funds for the replacement contract. Further, a termination would have exposed the Government to continuation of increased operation and maintenance costs for the NEXRAD radars beyond the period expected by negotiation. In addition, NWS radars would continue to lose critical severe weather data because of computer restarts caused by commercial power anomalies and experience increased wear on engine generators.

Page vii, second paragraph:

Delete the last sentence that starts: "Moreover, before contract"

REASON FOR CHANGE: Accuracy; the subcontractor had not demonstrated that its technology could satisfy the reliability requirement before contract award. The decision to make a change to static units was made in September 2000 and the contract modification was issued in November 2000. The claim that FAA units successfully completed factory testing in the summer of 2000 with these modifications is incorrect. ROC engineers were present in the factory at the time the units were being shipped and noted the units did not have the modifications as documented in the ROC engineering email report Subject: PPC Trip Findings July 6, 2000. The units were installed at FAA sites in November 2000, the same month contract modification 0022 was issued.

Page 4, paragraph 1:

Remove "Second, FAA did not need maintenance shelters and thus could save money by procuring TPS units directly from the manufacturer."

REASON FOR CHANGE: TPS only units and shelter TPS units were available for the FAA in the NOAA contract. The NOAA TPMS contract provided CLINs for both TPS only and sheltered TPS units to cover potential FAA requirements.

Page 4, paragraph 1:

Add "Note that the FAA 201-F sites had larger Engine Generators than NWS or DoD radar sites." after "...at all 12 of its NEXRAD sites."

REASON FOR CHANGE: The FAA modified the backup generator power by installing a much larger emergency generator at FAA radar sites prior to the installation of their rotary TPS units. This larger generator eliminates the compatibility problem of making a rotary TPS work with the limited capacity of the other NEXRAD radar engine generator sets.

Page 4, paragraph 3:

Add "model 201-F with 50KVA capacity" after "FAA began operating its first two new rotary".

REASON FOR CHANGE: The rotary TPS units described were the larger capacity FAA Model 201-F units with 50KVA capacity. The Model 201-N purchased under the NOAA contract has a 35KVA capacity rating.

Page 4, paragraph 3:

After ". . . twelfth and final unit in April 2003." add "Meanwhile, as of June 27, 2001, 61 existing TPMS sites under the NOAA contract had been retrofitted and accepted with static units and by July 31, 2001, 75 sites had been retrofitted and accepted."

REASON FOR CHANGE: This addition helps show the time lines of FAA activities compared to NWS contract actions. Waiting for the results of FAA field testing prior to executing the contract modification and retrofits would have delayed the NOAA contract modification, and subsequent field retrofit effort, by several months.

Page 6, paragraph 3:

Remove "and had the additional advantage of providing complete electrical isolation of the radar."

REASON FOR CHANGE: Both the rotary and static units have a common neutral with the radar meaning that neither technology provides "complete electrical isolation."

Page 6, note 13:

Change "On static units," to "On both static and rotary units,"

REASON FOR CHANGE: The problem described can occur on both static and rotary TPS systems.

Page 7, paragraph 4:

Following ". . . developed and thus was unproven at the time of contract award" add "however, the overall rotary design was a proven technology."

REASON FOR CHANGE: The overall technology of rotary TPS units was proven by ROC tests. The specific model bid against the NOAA solicitation was unproven.

Page 8, paragraph 2:

Change "8 control failures" to "8 catastrophic failures."

REASON FOR CHANGE: The recommended change makes the terminology consistent with the terminology used on page 3, paragraph 3.

Page 8, paragraph 3:

Remove ". . . the TPS specification and results of the ROC's testing do not support this position" and change to read ". . . the analysis by the rotary TPS manufacturer, installation testing at Grand Junction, CO, and the FAA decision to install larger motor-generator sets and rotary TPS units at FAA NEXRAD sites support this position."

REASON FOR CHANGE: There are two issues of concern. One issue is the size of the TPS NOAA specified. The second is the need for larger generators at high altitude sites. The size of the required TPS unit was not changed from the original 35KVA requirement. Bidders and the rotary manufacturer chose to bid a new unit rather than the original model 35-60 unit tested by ROC engineers. The choice to offer a new unit was made by bidders, not the Government. There was a concern on the ability of that unit to operate at FAA sites. ROC engineers anticipated there may be a need to operate two model 35-60 units in parallel at FAA sites because of the mode of operation at those sites. In the meantime, the FAA had made the decision to install larger motor generator sets for FAA NEXRAD sites. The rotary manufacturer notes the need to derate engine generators at high altitudes in that company's technical literature. This does not mean a larger TPS unit is required, but rather a larger emergency motor-generator set is required at high altitude sites to "spin" up the rotary TPS from a dormant state or to return the rotary TPS to full speed after it slows down during a power transition. Because motor generator sets are not as efficient at higher altitudes, the normal NEXRAD motor generator set that worked successfully at lower altitudes did not work well with the rotary TPS at high altitudes. The need for larger motor-generator sets at high altitude sites was confirmed by the installation testing of the rotary TPS at Grand Junction, CO. The FAA change to a larger

motor-generator set and a larger rotary TPS confirms the demands a rotary TPS makes on a motor generator set.

Page 10, Table:

Change the table as follows:

Comparison of NWS and FAA Rotary TPS units

	NWS Model 201N	FAA Model 201F
Power	36KVA/28KW	50KVA/40KW
Size	40" deep-Note 1	50" deep-Note 1
Startup Current	100 Amps	111 Amps
Material	Aluminum End Bells	Cast Iron End Bells
Weight	7500 lbs	11,665 lbs
Bearing Automatic Regreaser	No	Yes-Note 2
Voltage Regulation (Ride Through)	+/- 5%	+/- 8%
Improved Firmware	No	Yes
Vibration Monitor	No	Yes
Improved Motor Magnets	No	Yes
Step Load	+/- 10% for 100% step load	-15% and +10% for 50% step load
Ride Through	18 sec	12 sec
Poles (1800 rpms)	4	4
Remote Maintenance System	No	Yes-Note 3
Note 1: Model 201N fits in the NWS shelter; model 201F does not fit in a shelter		
Note 2: Was not available in the summer of 2000; was proven by final acceptance tests in March and June 2001		
Note 3: Unique requirement for FAA		

REASON FOR CHANGE: The revised table better depicts the similarities and differences between the FAA and NWS rotary TPS units and shows all of the improvements needed for the Model 201N that were subsequently included on the Model 201F.

Page 10, paragraph 1:

After ". . . same TPS model with the corrections incorporated - for use on its own NEXRAD systems." Add "The first 2 FAA units installed at Kenai and Fairbanks were put into operation and conditionally accepted on November 3, 2000. Full acceptance for the Kenai unit occurred on March 19, 2001, and for the Fairbanks unit on June 1, 2001." Also, add the following before the final sentence: "ROC engineers witnessed tests on interim fixes that failed to perform as expected. When ROC engineers visited the manufacturers plant in July 2000, they saw the FAA units that were factory tested prior to being shipped to Alaska. The FAA TPS units did not have new firmware or regreasers installed at that time."

REASON FOR CHANGE: The time line is a bit misleading without the additional information. The FAA did not fully accept the two units mentioned until 2001. ROC engineers witnessed tests of interim fixes and those fixes failed to perform. The FAA model 201F units being tested in the factory had neither the interim nor the permanent fixes being proposed for the Model 201N units purchased by NOAA, as documented in a ROC engineering email report dated July 6, 2001.

Page 11, Table:

Add "May 13, 1998, Project Management Status Report documented performance and reliability issues with first 2 units installed."

Add "April 1999, OSF/COTR E-Mail to prime (coordinated with NOAA contracts) on back feed, voltage regulation/stability and reliability problems."

Add to the March 1998-April 2000 bullet 94 TPS units are installed "experiencing performance and reliability problems."

REASON FOR CHANGE: Some significant early events concerning reliability of the rotary TPS are not included on the time line. In addition, the table does not note the 94 units installed had numerous problems.

Page 12, paragraph 1:

Remove "aluminum construction" and replace with the "TPS resonant 120hz frequency."

REASON FOR CHANGE: The independent consultant finding was that the TPS design resulted in a resonance at 120hz, thus causing vibration. This was not technically due to the aluminum material used but rather

the failure to check the overall design for resonance. Resonance caused the rotary unit to vibrate constantly with the 60hz input since the resonance was a multiple of that frequency (120hz). If it was not resonant at 120hz, the causes of vibration would have been limited to balance and writing of poles.

Page 12, paragraph 1:

Remove "Replace the aluminum motor end bell with iron. Improve the firmware for better motor field control. Improve vibration monitoring. Install a system to continuously lubricate the bearings.", and the associated footnote (#20). And create a text box with the following title: "Vibration Consultant Recommendations" and include the following information: "1. Install iron end bells in order to shift rotor 3rd critical out of 120hz electrical excitation range, i.e. separate cross talk of the electrical and mechanical resonances. 2. Minimize the excitation forces upon the rotor through better firmware control of the fields. Shorter bumps and finer control is needed to "catch" the upsets (Bad fields, Field hunts, etc.) of the system faster thus reduce the duration and magnitude of the excitation forces. 3. Implement continuous relubrication of the bearings to avoid "dry runs" prior [to] the bearing reaching operating temperatures as well as to extend the grease life. If acceptable, use KLUBER Topas NB 152 grease of [or sic.] at least MOBILITH SCH 100 grease. (USN study CARDIVNSWC-TR-63-94/02). To avoid the "cold cage and ball rattling" some bearing axial preload should be considered. 4. To insure timely detection of the bearing degradation the vibration monitor (PPC Cards) should be used. The overall vibration will not detect bearing component faults in a timely manner. 5. As a last and probably least necessary recommendation. The parties should consider installation of unit mounts with longer life. As mounts age changes in stiffness could introduce unknown frequencies that might influence the resonance of the system. As we do not know the usable life span of the mounts the time in service becomes the main factor."

REASON FOR CHANGE: The wording of the recommended footnote is a quote directly from the vibration study. The wording used in the report is incomplete and inaccurate in some cases.

Page 12, paragraph 3:

After ". . . NWS that operating the units would not pose a safety hazard." add "However, NWS field technicians were not qualified to work on the rotary units at this time, the rotary units were still under warranty and the units were not meeting the specified performance and reliability requirements."

REASON FOR CHANGE: The report does not state the major reasons why shipping parts to the sites for installation by government staff was unacceptable.

Page 12, Table:

After ". . . Two FAA units successfully complete factory acceptance testing" add "Without antihunt software and regreaser."

REASON FOR CHANGE: The proposed change clarifies the time line of changes to the FAA systems. These FAA units were observed by ROC engineers in the factory as they were ready for shipment in early July as documented in a ROC engineering email report dated July 6, 2000. The units had neither interim nor permanent modifications installed at that time.

Page 13, paragraph 1:

Add the following sentence to the end of the paragraph: "In the meantime, NWS engineers continued to monitor and observe testing of fixes to the rotary units into mid-July 2000."

REASON FOR CHANGE: Even though NWS engineers were testing static units, they followed progress on developing fixes for rotary units. In mid-July 2000, NWS engineers visited the subcontractor's factory as a part of contract monitoring and observed tests to FAA rotary units prior to their shipment to Alaska. These rotary units did not have the modifications proposed by the subcontractor for NOAA rotary units.

Page 13, paragraph 2:

Recommend the paragraph be deleted.

REASON FOR CHANGE: The decision to change to the prime contractor's static TPS was the best business decision. In making the decision, the following points were considered:

1. An average savings of \$2,300 in spare parts was realized at radar sites (with poor commercial power), whether static or rotary in design. The major reason TPS units were needed was to eliminate computer restarts and lost data caused by commercial power anomalies and reduce fuel costs and run time on engine generators. It was in the Government's interest to install an adequate, reliable TPS.
2. Interim fixes proposed by the rotary manufacturer (antihunt software and vibration detection) were tested and proven to have no improvement on rotary TPS performance or reliability.
3. The permanent fixes proposed by the rotary manufacturer (regreaser and iron end bells) were not yet available and tested, even on the FAA rotary model 201F TPS units that were tested in July 2000.
4. The prime contractor's static TPS was tested and was compatible with the NEXRAD radar.

5. Another static TPS unit, such as the Mitsubishi, was more costly and could not be retrofitted as quickly as the prime contractor's unit.
6. The Government refused to accept the rotary manufacturer's recommendation that government technicians retrofit rotary units for the following reasons:
 - a. Government staff were not qualified or trained to perform the installation.
 - b. TPS units were under warranty, so work related to installing fixes was the manufacturer's responsibility.
 - c. The viability of the fixes was not yet proven and the TPS units in the field were not meeting performance or reliability requirements.
7. The Government turned off all rotary TPS units for two reasons:
 - a. There was concern the units may fail catastrophically, causing more damage and endangering NWS staff.
 - b. The Government was gaining the benefit of operations and maintenance savings by continuing to use the operational rotary TPS units. At the same time the Government was concerned over the performance and reliability of the units. Continued TPS usage would limit the Government's rights for future contract decisions.

The following time lines pertain to the decision made to change to a static TPS:

1. The May 13, 1998 Project Management Status Report documented a TIM in which the Government expressed concerns about TPS performance and reliability.
2. By summer 2000, the Government had tested interim changes proposed by the rotary manufacturer (vibration sensor and antihunt software); permanent solutions (iron end bells and regreaser) were not available for testing.
3. In mid-July 2000 FAA rotary TPS units were factory tested, but those units did not have the permanent fixes recommended by the rotary manufacturer.
4. In September 2000, NWS management made the decision to change to static technology.
5. In November 2000 the first FAA rotary TPS units were accepted on an interim basis.

6. November 2000 contract modification 0022 for the static TPS units was issued.
7. December 2000 retrofit of rotary TPS units with static TPS units began.
8. March and June 2001 the first two FAA rotary TPS units are fully accepted.
9. September 2001 retrofit of rotary TPS units with static TPS units is completed.
10. The following pertains to the retrofit of rotary TPS units.
 - a. When discussing options for retrofitting the rotary units, the subcontractor advised they could only retrofit one unit per week, meaning the entire retrofit would take 22.5 months.
 - b. The prime contractor began retrofit of rotary units in December 2000 and completed retrofit in September 2001.
 - c. The fixes for the rotary unit were first installed and initially accepted at FAA radar sites in November 2000. The units were not finally accepted until March and June 2001.
 - d. Waiting until the rotary fixes were tested and proven for NEXRAD use meant a delay in starting the retrofit until the summer of 2001 when the FAA units were finally accepted.
 - e. The rotary option meant a delay in completing the retrofit of approximately 18 months, during which time the benefits of lower operations and maintenance costs and the operational benefits of eliminating computer restarts and lost data caused by commercial power anomalies, would have been lost to the Government.

Page 14, paragraph 1:

After "the prime submitted a second VECP" add "containing 2 rotary and 1 static options."

REASON FOR CHANGE: Accuracy; the VECP had two options relevant to rotary technology and one option offering static technology.

Page 14, table:

After "using iron end bells to reduce vibration" add "by changing the resonant frequency from 120hz."

REASON FOR CHANGE: Accuracy; as described above, the vibration problem was caused by the frame resonating at a frequency of 120hz.

Page 14, table:

Add to the end of the table: "Subsequently, the subcontractor has altered its position on shipping. For recent rotary installations at FAA NEXRAD sites, the subcontractor shipped the units and then replaced the bearings on site."

REASON FOR CHANGE: Accuracy; FAA engineers on site during subsequent installations at FAA sites advise the subcontractor routinely ships rotary units with old bearings and changes them on site.

Page 15, paragraph 4:

Remove "but they frequently have lower recurring cost, making them less expensive on a life-cycle basis."

REASON FOR CHANGE: Accuracy; the FAA units require yearly bearing replacement as well as frequent maintenance of the re-greaser unit. In addition, during the May 4, 2000 meeting with the prime and subcontractor, the subcontractor also recommended yearly bearing replacement in addition to a status monitoring system for the rotary unit. The monitoring system requires an additional telephone line at each NWS and DoD radar site at an additional monthly cost. (The FAA's unit is monitored by the RMS connection and does not require a separate monitoring system.) ROC life cycle cost analysis showed the static TPS would be \$14M less costly assuming a three year bearing replacement cycle. An annual bearing replacement cycle makes the static TPS life cycle cost even more beneficial.

Page 15, paragraph 5:

Remove "Moreover, NOAA failed to seriously examine alternative static TPS technology"

REASON FOR CHANGE: Accuracy; the NWS investigated alternative static units. After a visit by a manufacturer's representative, the NWS was planning to purchase a Mitsubishi unit for test. The effort was terminated on May 25, 2000, when it was assessed that testing such a unit could be interpreted as directing the Prime's engineering solution.

Page 17, paragraph 1:

Change first sentence to read: "Concern about the compatibility of the static TPS, along with static TPS generated noise interfering with the sensitivity of the signal processor, were among the reasons the ROC initially concluding that static technology would be problematic for NEXRAD." Add to the end of the paragraph: "Nonetheless, the static unit provided by the prime contractor meets the reliability figures in the NOAA specification."

REASON FOR CHANGE: The generator compatibility was only one of the major issues considered when examining TPS technologies. The subsequent change to a static technology was considered by the NWS to be best value to the Government. The prime's static was a proven and stable technology that met the reliability and performance specifications and the integration approach was standard throughout industry. Subsequent reliability data over 1.9 million hours of operation shows it is compatible with the engine generator. The alternative static technology was examined and found to be more expensive to acquire and would take longer to implement via retrofit. In the end, the approach implemented allowed the NWS to provide a critical technical requirement much earlier than other options and benefit from lower operations and maintenance costs as well as eliminating computer restarts and lost data caused by power anomalies.

Page 17, paragraph 2:

After ". . . used 6-pulse silicon controlled rectifier (SCR)" add the following: "in both the rectifier assembly and inverter assembly."

REASON FOR CHANGE: The design of the static TPS initially investigated by the ROC in 1994 was not the same design as the static TPS installed by the prime contractor under the TPS project.

Page 18, paragraph 2:

Change paragraph to read "Since the time of the ROC's TPS evaluation in the early 1990s, newer rectifier and inverter designs have become available. These new designs use insulated-gate bipolar transistor (IGBT) semiconductors in the rectifier and inverter or, in the case of the static TPS installed by the prime contractor, in the inverter only. The use of IGBTs in the rectifier reduces reflected THD, which somewhat reduces reflected energy to the engine generator set and lessens incompatibility problems between the TPS and the engine-generator. The prime's static TPS uses a 6-pulse SCR in the rectifier, which produces higher levels of reflected THDs than a static TPS with IGBTs."

REASON FOR CHANGE: This clarifies that IGBTs are used in the TPS provided by the prime contractor on the inverter, but that SCR technology is used in the rectifier. This further clarifies that use of IGBT technology in the rectifier does not eliminate reflected harmonics. The specifications for the Mitsubishi TPS using IGBTs in the rectifier state the THDs are 5-7 percent into a full linear load. The reflection can be expected to be higher into a dynamic load like the NEXRAD radar.

Page 18, paragraph 3:

Change the third sentence to read: "However, the energy reflected back to the motor-generator, or THD, was 19 percent for voltage and 10 percent for current."

REASON FOR CHANGE: The change clarifies that the voltage and current THDs discussed are THDs reflected back to the motor-generator set.

Page 19, first full paragraph:

After first sentence add: "The performance of the units was monitored for anomalies up until the time the decision to change to static TPS units. The performance of all static TPS units installed has been monitored constantly since the decision to use that technology."

REASON FOR CHANGE: The NWS continues to monitor performance of the static TPS units to determine the long term compatibility with the NEXRAD system. By early September 2000 when the decision was made to change technology, the units had accumulated 4 months of operational time. As of the end of June 2003, all units have operated a total of 1.9 million hours.

Page 19, first full paragraph, first bullet:

Change "25 percent" to "20.6 percent for a single cycle."

REASON FOR CHANGE: A review of the El Paso test data on the engine generator stability run shows there were no voltage THD values above 20.6 percent.

Page 19, last paragraph.

In the fourth sentence, put a period after "full radar load," delete the remainder of the sentence, and add the following: "This change ensured the TPS worked with the actual dynamic load in question rather than a less stringent, static load in a factory test bed. The full radar load averages 50 percent of the TPS capacity, but has short duration, peak demands that exceed the rated TPS capacity." Replace the remainder of the paragraph with the following: "Contract modification 0022 added a voltage figure of 15 percent and changed the THD figures from maximum limits to average figures."

REASON FOR CHANGE: The previous explanation of the TPS specification is in error. A static TPS produces its lowest levels of Reflected THD at full **linear** load. Measurement at **full radar load** also takes into account the fact that the static TPS, in this application, is not fully loaded with a linear load: The static TPS the NWS acquired is a 50KVA/40KW unit. The full radar load is approximately 50 percent of the capacity of that TPS. Also, the full radar load is very nonlinear. By specifying the Reflected THD at **full radar load**, the NWS is ensuring that the TPS performs under operational loads rather than an artificial, linear load as represented in a factory test.

Page 20, paragraph 2:

After "static TPS and no negative effects have been observed" add "after 1.9 million hours of operation as of June 30, 2003."

REASON FOR CHANGE: Accuracy; this is the latest reliability data on the static TPS.

Page 20, paragraph 2:

Remove "but no static TPS other than that of the prime was evaluated."

REASON FOR CHANGE: This is incorrect. Other technology was evaluated, but the results of that evaluation were not well documented. No actual testing of an alternative technology was done since such testing was interpreted to be directing the contractor's solution.

Page 21, Paragraph 2:

Add to the end of the paragraph: "Some of the differences in reliability are due to local power quality and the differences between NWS and FAA in routinely testing the emergency power subsystem. NEXRAD radars typically are located in rural areas with poor power while TDWR radars are in urban environments with much better commercial power quality. ROC engineers observed some NEXRAD sites were subjected to as many as 100 power anomalies in a six-month period, causing the TPS batteries to cycle, thus deteriorating the life of the batteries. IEEE recommends engine generators be tested under load weekly. The NWS tests all systems that have a TPS on a weekly basis. Not only does this test the engine generator, but it also tests the entire emergency power distribution subsystem, allowing for the discovery and correction of TPS failures on a weekly basis. The FAA does not perform the recommended IEEE test on TDWR engine generators and TPS units, so failures are reported when discovered during actual field failures. This difference in testing philosophy tends to skew the reliability data in favor of the system not undergoing periodic tests."

REASON FOR CHANGE: Data indicates an apparent difference between TDWR and NEXRAD TPS reliability. Some of the differences in reliability are attributable to differences in commercial power quality and the fact that the NWS tests the TPS weekly for failures while the FAA only reports failures discovered during actual operation of the TPS. This means NWS may report more failures than the FAA since FAA failures can go undetected for long time periods.

Page 22, paragraph 2:

Remove "Another factor may be that - according to the manufacturer of the TDWR TPS - TPS technology with the newer rectifier design extends battery life because step loading does not drain the batteries."

REASON FOR CHANGE: This was tested at El Paso, and there was no evidence to support this statement. Another claim by the TDWR static manufacturer that the prime's unit has issues with DC voltage ripple and decreases battery life was also tested. ROC testing also found

this not to be the case. In fact, the NOAA prime's static unit performs to the TDWR TPS manufacturer published specifications.

Page 27, paragraph 4:

Remove or revise "We found that the recommended negotiation approach was not used."

REASON FOR CHANGE: Although the report states the recommended negotiation approach discussed in the presentation on September 6, 2000 was not used, in fact it was. However, the negotiations did not succeed in overcoming the specification problem. The "best value" approach was based upon an expectation of the willingness of the contractor to negotiate and to accept some responsibility for the performance problems in spite of its contention that the specifications were impossible to perform to avoid possible litigation if the Government considered that contention defensible.

Page 27, paragraph 4:

Remove or revise "Instead, NOAA accepted the prime's contention that the specification was impossible to perform."

REASON FOR CHANGE: There is a substantial difference between acceptance of the position because of being convinced and acceptance because the position that the specifications were possible to perform but concern that this position was likely indefensible enough for the Government to sustain a termination for default. The alternative, termination for convenience, whether by choice or through conversion through legal action of a default termination, would expose NOAA to a substantial claim and at some point require additional funds for the replacement contract. Further, a termination would have exposed the Government to continuation of increased operation and maintenance costs for the NEXRAD radars and loss of critical radar data beyond the period expected by negotiating to restart performance.

Page 31, paragraph 3:

Add to the first sentence: "and negotiation and prepared modification 0022."

REASON FOR CHANGE: Accuracy; this individual had significantly more knowledge of the contract than anyone else in the contracting office, was the government's lead negotiator, and had detailed knowledge of the changes agreed upon between the prime and himself.

Page 32, paragraph 4:

Remove "and installation had already been included on those purchase orders." Also remove the last sentence that starts: "Although credit was given for the total installation cost, inclusion of these costs made the discount larger that (sic) it actually was."

REASON FOR CHANGE: Accuracy; the installations were temporary with the units installed in the work room with temporary wiring strung through the door and a temporary window air conditioner placed in a plywood door insert. This was not a permanent installation for continued field use. Since the testing installations were not permanent and the static TPS units in question needed to be installed permanently, the sentence is incorrect.

Page 33, paragraph 3:

Remove from the first sentence "and no official we interviewed was able to identify who actually negotiated the settlement."

REASON FOR CHANGE: Accuracy; as addressed earlier, the assigned contract specialist negotiated the agreement for the modification. Extensive discussions were conducted by the contract specialist with assistance from the OOS lead engineer and the ROC-based COTR in review of pricing data in support of the static units, rotary unit removals and disposal, static unit installations, and shelter modifications and in discussions with the prime's contract manager and the various members of the prime's project team. The contract manager clarified the genesis of the November 2, 2000, proposal recently to the contracting officer. The contract manager said he sent to the contract specialist several revisions of the October 6 proposal including the one dated November 2, 2000, mentioned in the audit report. The contracting officer was severely hampered by the abrupt departure of the contract specialist, who knew the details of his actions and negotiations and had been intensely involved with the analysis. Consequently, others in the contracting office struggled with addressing the concerns raised by the legal counsel to complete the modification.

Page 34, paragraph 3:

Replace the date of November 17, 2000, with the date of November 29, 2000, for the undated memorandum. This change should be made elsewhere in the report where reference to this document is made.

REASON FOR CHANGE: Accuracy; the undated memorandum was drafted, reviewed, revised, starting November 20, 2000, until it was finalized and signed on November 29, 2000. A notebook entry by the contracting officer noted the telephonic approval by the attorney and the date. Other references to this memorandum in the remaining parts of the report need the same correction.

Page 35, paragraph 2:

Place a period after ". . . they supported the prime's claim." and delete the rest of the sentence. Add a footnote as follows: "ROC engineers documented their opinion in a memorandum dated August 14, 2000."

REASON FOR CHANGE: Accuracy; ROC engineers did document this portion of the specification was impossible to meet.

Page 37, paragraph 1:

After ". . . bearing problem was insufficient lubrication and excessive vibration" add "caused by the unit being resonant at 120hz."

REASON FOR CHANGE: Accuracy; as described elsewhere, the primary cause of vibration cited by the independent consultant was the unit being resonant at 120hz.

Page 37, paragraph 3:

After ". . . with an iron end bell to reduce vibration" add "by changing the unit's resonant frequency."

REASON FOR CHANGE: Accuracy; as described elsewhere, the primary cause of vibration cited by the independent consultant was the unit being resonant at 120hz.

Page 40, paragraph 1:

Add the words "based on information found during the audit despite the determination of the contracting officer" at the end of the second sentence.

REASON FOR CHANGE: Accuracy; the contracting officer determined the change was within the general scope of the contract. The conclusion of this section of the report is based on information not known to the contracting officer. The information with the change request from the ROC did not provide concerns about the scope of work. The prime contractor did not dispute the change in requirement or otherwise raise any objections to the contracting officer in discussing the requirement or providing a proposal. The contracting officer decided the replacement was within the general scope of the contract inasmuch as this was a change in the specification to enable the TPS to function at the particular sites included, similar to the site changes needed for the TPMS placements. The statement from the May 13, 1998, Project Management Status Report referenced could be construed that the contractor was not responsible for corrections under the contract; i.e., the work would be at additional cost. Although there was no legal review found in the file, the OOS engineer recalls a discussion with a contracting officer, who was working on an earlier version of the modification, and the attorney. During this verbal exchange, the change of the engine generators at a limited number of sites was discussed and agreed upon as being in scope. Although the attorney does not have this recollection, he believes the issue to upgrade the generator is within the contract scope, but is a close call. Although generator upgrades were not specifically provided for in the contract, the intent of the contract may well be thought of as providing the items necessary to assure a comprehensive power backup solution to the

NEXRAD system at the lowest life cycle cost. Replacements only were needed at those sites needing sufficient generator power to the radar and the TPS. Looking at the contract from that view, upgrade of a small number of generators to meet the power requirement may be within contract scope.

Page 40, paragraph 2:

After "high-altitude sites, and required a larger engine generator." add "This was verified by rotary acceptance testing at Grand Junction, CO." Remove "These were needed to accommodate the larger air conditioning (A/C) units required for static TPS units that were replacing the installed rotary units."

REASON FOR CHANGE: Accuracy; the Yuma site has three (not two) site A/Cs and other loads that are not normal at the average NEXRAD site. Measurements by Western Region showed the utility service being used near 100 percent of capacity. At the average NEXRAD site, power usage is less than 50 percent of capacity. The site required a power upgrade for either a static or a rotary TPS, not just because a static was installed. Also, a rotary TPS was never installed at Yuma. The Norman test bed has several modifications requiring a larger generator which are unique to the test bed nature of the site.

Page 41, Conclusion: Suggest revising conclusion based on information provided in this response.

Response to OIG Recommendations

Recommendation 1: The Assistant Administrator for Weather Services and the Director of NOAA's Acquisition and Grants Office should ensure in future acquisitions that the items selected and contracted for have been thoroughly evaluated and determined to have the capability to meet all critical requirements within acceptable levels of cost, schedule, and technical risk.

Recommendation 2: The Assistant Administrator for Weather Services and the Director of NOAA's Acquisition and Grants Office should ensure in future NWS acquisitions that all reasonable alternatives for the items being procured are identified, thoroughly analyzed, and well documented.

Recommendation 3: As in finding 2, we recommend that the Assistant Administrator for Weather Services and the Director of NOAA's Acquisition and Grants Office ensure in future NWS acquisitions that all reasonable alternatives for the items being procured are identified, thoroughly analyzed, and well documented.

Recommendation 4: The Assistant Administrator for Weather Services should ensure that NWS managers take the following actions:

1. In future acquisitions of complex COTS or developmental items,
 - a. clearly assign and enforce the program management accountability and responsibility, and
 - b. give management responsibility and technical leadership of the acquisition program to personnel with appropriate acquisition and technical expertise and experience.
2. In future acquisition for NEXRAD,
 - a. effectively coordinate activities and share information between the ROC and headquarters, and
 - b. effectively coordinate activities and decisions, and share information among the NEXRAD tri-agency partners.
3. Ensure the COTRs are aware of their responsibilities and are held accountable for,
 - a. achieving the cost, schedule, and technical performance goals of the contract and program;
 - b. making appropriate trade-off among these goals when necessary; and

- c. providing clear and accurate information and advice to the contracting officer and senior program and agency officials.
4. Ensure that program managers are aware of their responsibilities and are held accountable for
 - a. achieving the cost, schedule, and technical performance goals of the contract and program;
 - b. making appropriate trade-off among these goals when necessary; and
 - c. providing clear and accurate information and advice to senior agency officials.

Recommendation 5: The Director of NOAA's Acquisition and Grants Office and Assistant Administrator of Weather Services should take the necessary action to ensure that:

1. Quality assurance and review procedures for significant procurement actions are established and implemented that clearly stipulate roles and responsibilities, and assure appropriate oversight and accountability.
2. Contracting personnel receive the appropriate training in cost and price analysis and negotiation techniques.
3. To enhance the government's negotiating position, contracting officers seek and receive comprehensive explanations from technical personnel regarding applicable technical issues.

Recommendation 6: In future NWS acquisitions, the Assistant Administrator for Weather Services and the Director of NOAA's Acquisition and Grants Office should take the necessary action to ensure that:

1. NWS' needs are stated in specifications as performance requirements rather than design requirements whenever feasible;
2. Specifications receive integrated technical, contractual, and legal review; and
3. Draft solicitations are issued for industry review and comment when appropriate.

Recommendation 7: In future NWS acquisitions, the Assistant Administrator for Weather Services and the Director of NOAA's Acquisition and Grants Office should ensure that there is adequate review and oversight of proposed modifications to verify and document that they fall within the scope of the contract they are modifying.

Recommendation 8: The Under Secretary for Oceans and Atmosphere should ensure that the Assistant Administrator for Weather Services and the Director of NOAA's Acquisition and Grants Office take the following actions:

1. Undertake a review of their acquisition policies, procedures, and oversight to identify actions needed to prevent similar problems from occurring on other acquisitions. The results of this review should be documented and should include a time line for implementing actions to be taken.
2. Determine whether any personnel involved in the TPS acquisition require additional training or closer supervision and provide these measures as appropriate.

NOAA Response: NWS and NOAA's Acquisition and Grants Office concur with all recommendations. The May 2002 NOAA Program Review has already addressed many organizational and program management processes applicable to system acquisition. The lack of current and effective policy and process for acquisitions in NOAA has been previously identified as a critical need. The Director, Acquisitions and Grants Office, has begun a baseline assessment of those policies and processes to identify gaps. Working with the Department of Commerce Procurement Executive, a NOAA Acquisition Handbook will be developed over the course of Fiscal Year 2004 to provide mandatory direction on acquisition policy and process in NOAA. The Handbook will be applicable to all acquisitions in NOAA and will be utilized across all of NOAA's acquisition offices.

The Handbook will include guidance on, but not limited to:

- Identification, analysis, and documentation of reasonable alternatives for items being procured.
- Clear documentation of alternative analyses, and technical and programmatic decisions, as well as roles and responsibilities.
- Quality assurance and review procedures.
- Cost and price analysis and negotiation techniques.
- Seeking and receiving comprehensive explanations from technical personnel.
- Performance requirements.
- Integrated technical, contractual, and legal review.
- Industry review.

- Adequate review and oversight of proposed modifications.
- As sections of the Handbook become available, they will become effective, prior to October 2004.

Further, organizational structure changes in the Acquisition and Grants Office since the time frame of the actions in this report have aligned the staff with the line offices they support. This has improved communications between procurement and technical staffs. A further NOAA benefit is improved program knowledge and application of cost and price analysis and negotiation techniques to supported projects. A complete analysis will be performed to determine what acquisition training has been completed by all acquisition personnel. To the extent that funds are available for training, NOAA will aggressively pursue enrollment and completion of appropriate, needed training. Recognizing the limitation of funds available for training, alternative means for educating acquisition personnel will be pursued.

Since the time frame of initial procurement and many actions in this report, the NWS organization structure has been realigned with product improvement activities and responsibilities falling under the Office of Science and Technology. The collaborations of the Offices of Science and Technology and Operational Systems has resulted in clearer line of authority, improved coordination, program control, accountability, and tracking of performance and schedule.

The NWS has contracted for two training sessions on development of performance based statements of work (PBSW). During 2002, a total of 69 NWS personnel were trained.

The NWS is ensuring program manager and COTR functions are well defined - additional training identified, accountability requirements spelled out, key decision points identified, and decisions coordinated and vetted. Increasing management oversight and accountability is ensured through direct participation in program reviews and key decisions.

Target Date for Completion:

<u>Event</u>	<u>Date</u>
• Establish clear review processes to ensure proposed acquisitions are occurring at the proper organizational level at all dollar thresholds.	September 2003
• Complete acquisition training needs assessment (project officer, COTR, acquisition specialist, etc.)	October 2003

- Additional PBSW Training (required for individuals developing Statements of Work) November 2003, (periodically thereafter, as required)
- NOAA Acquisition Handbook-Outline December 2003
- Acquisition Training (required for individuals involved in acquisition. Levels of training dependent on acquisition role, e.g. contracting officer, contract specialist, program manager, project engineer, COTR, etc.) February 2004, (periodically thereafter, as required)
- Enhanced COTR training (required for individuals performing COTR functions) March 2004, (periodically thereafter, as required)
- NOAA Acquisition Handbook-draft May 2004
- Contract Management Training (required for noncontractual individuals managing contracts, day-to-day) August 2004
- NOAA Acquisition Handbook-Final October 2004