

**FAA NEEDS TO REEVALUATE STARS
COSTS AND CONSIDER OTHER
ALTERNATIVES**

Federal Aviation Administration

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Memorandum

U.S. Department of
Transportation

Office of the Secretary
of Transportation
Office of Inspector General

Subject: ACTION: FAA Needs to Reevaluate STARS
Costs and Consider Other Alternatives
AV-2003-058

Date: September 9, 2003

From: Alexis M. Stefani 
Principal Assistant Inspector General
for Auditing and Evaluation

Reply to
Attn. of: JA-10

To: Federal Aviation Administrator

We are providing you with the results of our audit of the Federal Aviation Administration's (FAA) strategy for terminal automation modernization. Our objective was to determine if FAA's terminal strategy is reasonable and cost-effective. FAA is modernizing the terminal air traffic control environment by replacing aging automation and display systems at the Nation's terminal air traffic control facilities. Modernizing the terminal automation environment will provide the necessary platform for a range of future capacity-enhancing technologies, such as new automated controller tools.

In 1996, FAA selected the Standard Terminal Automation Replacement System (STARS) as the centerpiece of its terminal automation modernization strategy (the terminal strategy). STARS is not the same program that was planned 8 years ago, and the cost estimates and benefits that support the initial acquisition strategy are no longer valid. STARS acquisition cost estimates have nearly doubled from \$940 million to \$1.69 billion, and FAA has delayed completing the deployment of STARS by 7 years. Over the past 5 years, due to delays in the STARS program, FAA deployed Common Automated Radar Terminal System (Common ARTS) hardware and software to 141 terminal facilities, or over 75 percent of the facilities where FAA intends to deploy STARS.

FAA's next step is to ensure that the Agency moves forward with a cost-effective and affordable terminal modernization strategy. There is little room for further cost growth and schedule slips with large acquisitions such as STARS. According to FAA's draft strategic plan, Flight Plan 2004-2008, the Agency must control program costs, refocus investment priorities on programs that perform, and make

management decisions based on sound business principles. These are fundamental management principles that should apply to all acquisitions, including STARS.

On August 21, 2003, FAA provided comments to our July 28, 2003 draft report. FAA concurred with three of the recommendations in our report. However, FAA did not comment on our recommendation to put at least \$221 million to better use nor did the Agency state that it would select the most cost-effective alternative to complete terminal modernization. In our opinion, by implementing our recommendation, FAA has a significant opportunity to cost-effectively complete the terminal modernization and save several hundred million dollars in STARS acquisition program costs. We have requested that FAA clarify whether it concurs with our recommendation and our estimate of funds that could be put to better use.

OBJECTIVE AND SCOPE

Our objective was to determine if FAA's terminal strategy is reasonable and cost-effective. We evaluated FAA's cost and schedule estimates for completing its terminal strategy; reviewed costs incurred to date for STARS and FAA's other terminal modernization program, Common ARTS; and analyzed alternatives to meet terminal modernization needs. We interviewed key FAA and contractor officials responsible for managing FAA's terminal modernization programs. On July 28, 2003, we provided a draft of this report to FAA for comment and have incorporated the Agency's comments where appropriate. We performed our work from December 2002 through July 2003 in accordance with Government Auditing Standards as prescribed by the Comptroller General of the United States. Exhibit A provides a detailed description of our audit scope and methodology.

BACKGROUND AND PRIOR AUDIT COVERAGE

Beginning in 1996, FAA's strategy was to replace aging 1970s era automation systems and displays with STARS at every terminal location in the National Airspace System. In September 1996, FAA awarded a contract to Raytheon Systems Company to develop and deploy STARS. At that time, FAA established an acquisition cost baseline for STARS of \$940 million for system development, procurement, and installation. FAA planned a completion date of 2005 for 188 systems. FAA also estimated the total cost of STARS over the system's anticipated life span (i.e., the life-cycle cost), including acquisition, technical refresh of hardware and software, and operations costs, would be about \$2.9 billion.

FAA's original procurement strategy was to use commercially available hardware and software for STARS. In 1999, after finding significant human factors

problems, FAA revised its strategy to a large-scale, multi-year software development effort for STARS while successfully implementing an interim program, Common ARTS, to satisfy immediate modernization needs. To execute the revised strategy, program officials fragmented the development of STARS into seven separate software configurations, with each configuration having its own set of milestones for development and testing. Program officials projected that this redesign would add almost \$500 million to development costs and 3 years to the schedule. In 1999, program officials proposed a new STARS acquisition cost baseline of \$1.4 billion with a new completion date of 2008. They also raised the STARS life-cycle cost estimate to about \$4.2 billion.

In March and July 2001, due to concerns that STARS cost estimates were still growing, we recommended that FAA quantify all costs associated with delivery, installation, and testing of STARS, and evaluate if additional Common ARTS with color displays would be needed to support FAA's terminal automation needs.¹ Further, we recommended that this analysis include an independent assessment by an organization that would not have a vested interest in the outcome. FAA did not implement our recommendations in 2001, but is now in the process of quantifying STARS costs and having them independently assessed.

In March 2002, faced with further cost growth and delays, program officials increased the STARS cost estimate to \$1.69 billion. Program officials also raised the life-cycle cost estimate to about \$6.1 billion. Currently, FAA plans to deploy STARS at all terminal facilities, and the program office is revising cost estimates to implement this strategy. Thus far, FAA has spent approximately \$1.1 billion for STARS and estimates that the last system will become operational in 2012.

RESULTS IN BRIEF

Having commissioned STARS at Philadelphia, FAA is at an important crossroads—the Agency must decide the most cost-effective and affordable way to complete terminal modernization. In the near future, STARS program officials intend to ask FAA's senior decisionmakers² to approve a new acquisition cost baseline of \$1.69 billion. However, before any new cost baseline is approved, FAA needs to reevaluate cost estimates and consider other alternatives to deploying STARS to all terminal facilities.

¹ Efforts to Develop and Deploy the Standard Terminal Automation Replacement System, AV-2001-048, March 30, 2001; Status Report on the Standard Terminal Automation Replacement System, AV-2001-067, July 3, 2001.

² FAA's senior decisionmaking body for its investments is the Joint Resource Council. The Joint Resource Council makes corporate-level resource and investment decisions, and approves acquisition program baselines.

STARS acquisition cost estimates have nearly doubled from \$940 million to \$1.69 billion since 1996, and the vast majority of systems have not yet been procured and deployed. To complete the STARS deployment within the cost baseline of \$1.69 billion, the program office is counting on future cost “savings” of \$281 million that are not attainable. For instance, program officials are counting on generating more than half of these “savings” by shifting costs from the Facilities and Equipment budget to the Operations budget. Shifting these costs to the Operations budget is not considered cost “savings.”

Further, the STARS program office will not have credible cost estimates until program officials improve the process to manage the contract and obtain independent assessments of life-cycle costs currently underway. Although the STARS program office has taken some steps to improve contract management, the program office has not implemented an effective process to manage contract costs or determined what it will cost to add needed upgrades to STARS.

In addition to having incomplete cost data, program officials are planning to request the new acquisition cost baseline without considering alternatives that could result in significant savings, such as keeping Common ARTS at some locations. Before FAA senior decisionmakers approve a new baseline, STARS program officials need to:

- ***Complete Sufficient Analysis to Support Any Projected Program Savings.*** While we support the program’s efforts to avoid further cost growth, STARS program officials are premature in counting \$281 million in program “savings.” For example, program officials plan to save \$35 million by reducing telecommunications costs at some terminal facilities. However, a technical feasibility study to determine if this can be safely done will not be completed until October 2003. Also, more than half of the projected “savings,” \$147 million, is from transferring some Facilities and Equipment costs for sustainment, such as fixing and testing software, to the Operations budget.
- ***Develop and Implement an Effective Process to Manage Contract Costs.*** Last year, an FAA internal review found that contract management had not been a priority to the STARS program office, and the program lacked an effective contract management process. Since then, the program office has taken several steps to improve contract management. For instance, program officials are now requesting audits of proposed changes to the contract. While this may ensure that future contract costs are reasonable, more needs to be done. Since FAA awarded the STARS contract 7 years ago, the program office has never requested an independent audit of the billed costs on the prime contract. Without these audits, FAA has no assurance of the

integrity of contractor billed costs—which totaled \$688 million as of May 2003. Moreover, program officials are not reconciling differences between the contractor’s billed costs and FAA’s obligation and expenditure reports. Our analysis documented a \$41 million discrepancy between the billed contract costs and the obligation and expenditure report. Program officials have not reconciled and cannot explain this difference. Without assurance that the contractor’s billed costs or FAA’s expenditure reports are accurate, the program office cannot provide credible estimates of future contract costs.

- ***Determine What Capabilities Need to Be Added to STARS and at What Cost.*** While FAA has commissioned STARS at Philadelphia, the system is not ready for deployment to FAA’s largest and most complex terminal sites, such as Denver and Chicago, because the existing system has capabilities that do not exist in STARS. To determine what additional development still needs to be done, the program office conducted a “functionality gap analysis” in April 2003 that compared STARS to the existing system, Common ARTS. From this analysis, the program office identified over 90 functions that already exist in Common ARTS that are not in STARS. According to program officials, up to half of these functions can be easily resolved. However, other capabilities are more complex and costly. For example, FAA needs to add “radar gateway” to STARS. In Common ARTS, if the entire computer system fails, radar gateway allows Common ARTS to continue to display radar data to the air traffic controllers. The program office needs to finalize the “functionality gap” analysis and develop cost estimates and schedule milestones to add these features in STARS.
- ***Consider Reasonable Alternatives to Deploying STARS at All Locations.*** STARS program officials are planning to request a new acquisition cost baseline without considering reasonable and cost-effective alternatives, such as retaining Common ARTS at some locations. FAA officials maintain that STARS has unique capabilities that do not exist in Common ARTS. However, we have not seen sufficient evidence to justify FAA’s conclusion that the capabilities of STARS are far superior to the capabilities of Common ARTS, and both systems have been certified for use in the National Airspace System. In fact, in December 2002, FAA deployed Common ARTS to its new Potomac facility, with all new hardware, software, and color displays.³ Over the past 5 years, FAA has deployed Common ARTS hardware and software to 141 terminal facilities, including

³ Potomac incorporated air traffic control from five airports, including Washington Dulles and Reagan National, making it FAA’s third busiest terminal site.

10 of the largest sites, at a cost of \$239 million. These facilities represent over 75 percent of the locations where FAA intends to deploy STARS. At the 10 largest FAA facilities that use Common ARTS, air traffic controllers supported more than 14 million flight operations last year.

STARS is not the same program that was planned 8 years ago, and the cost estimates and benefits that supported the initial acquisition strategy are no longer valid. In 1999, FAA concluded that the benefits of investing in STARS had declined to the point where it would break even when compared with an investment in Common ARTS. Since then, FAA's life-cycle cost estimates for STARS have increased by nearly 50 percent, and deploying STARS to all sites may no longer be cost-effective. A reasonable alternative that FAA is not considering is to limit STARS deployments to 73 sites, while retaining Common ARTS at the remaining locations. We found this alternative could save FAA at least \$221 million in acquisition costs. Before FAA makes any additional decisions about STARS procurements, program officials should provide FAA senior decisionmakers with updated cost estimates and benefits analyses for all reasonable alternatives to full STARS deployment.

RECOMMENDATIONS

At this time, FAA must make a sound business decision on how to move forward with its terminal strategy. Before procuring any additional terminal systems to complete terminal modernization, we are recommending that FAA:

- Develop credible cost estimates and updated benefits analyses for all reasonable alternatives.
- Select the most cost-effective and affordable strategy to complete terminal modernization that would put at least \$221 million to better use by augmenting STARS deployments with Common ARTS.
- Reconcile differences between STARS prime contractor billings and FAA's obligations and expenditures reports.
- Obtain a cost incurred audit for the STARS contract from the Defense Contract Audit Agency.

AGENCY COMMENTS AND OFFICE OF INSPECTOR GENERAL RESPONSE

On August 21, 2003, FAA provided comments (see Appendix) to our July 28, 2003 draft report. FAA concurred with three recommendations. With regard to our first recommendation, FAA agreed to develop credible cost estimates and updated benefits analyses for all reasonable alternatives to complete the terminal modernization program. FAA intends to implement this recommendation by the end of September 2003.

With respect to our second recommendation, FAA did not state whether the Agency will select the most cost-effective strategy, nor did it comment on our estimated savings. FAA has a significant opportunity to cost-effectively complete the terminal modernization and save several hundred million dollars in acquisition program costs. Further, we believe that our estimate of \$221 million that could be put to better use is conservative and could be substantially higher if FAA does not achieve its projected \$281 million in “savings.” We consider this recommendation unresolved and request that FAA clarify whether it concurs with our recommendation and our estimate of funds that could be put to better use.

In response to our third recommendation, FAA agreed to reconcile differences between the STARS prime contractor billings and FAA’s accounting system. FAA plans to complete this action by December 31, 2003. Concerning our last recommendation, FAA agreed to obtain a cost incurred audit for the STARS contract from the Defense Contract Audit Agency. We request that FAA provide an estimated completion date for implementing this recommendation.

FINDING AND RECOMMENDATIONS

In June 2003, after more than 6 years of development and a near-doubling of acquisition costs, FAA commissioned the first STARS site at Philadelphia, but the vast majority of systems still remain to be procured and deployed. FAA's next step is to ensure that the Agency moves forward with a cost-effective and affordable deployment strategy.

In the near future, STARS program officials plan to meet with FAA's senior decisionmakers to request a revised acquisition cost baseline—this time for \$1.69 billion. Their latest cost estimate represents an 80 percent increase over the initial estimated acquisition cost of \$940 million for system development, procurement, and installation. In 2002, the program office also estimated the total cost of STARS over the system's anticipated life-cycle, including acquisition, technical refresh of both hardware and software, and operations costs, would be \$6.1 billion. In 1996, the life-cycle estimate was about \$2.9 billion. We are concerned that FAA senior decisionmakers will not have complete and accurate cost data to make a sound business decision.

We also found the program office has not implemented an effective process to manage contract costs and has not determined what it will cost to add needed capabilities to STARS. In addition to having incomplete cost data to move forward, program officials are planning to request the new cost baseline without considering alternatives that could result in significant savings, such as keeping Common ARTS at some locations. Before FAA senior decisionmakers approve a new baseline, STARS program officials need to:

- Complete sufficient analysis to support any projected program savings that have been factored in to the new estimate;
- Develop and implement an effective process to manage contract costs;
- Determine what capabilities need to be added to STARS, and at what cost; and
- Consider and develop cost estimates for reasonable alternatives to deploying STARS at all locations.

Program Officials Are Prematurely Crediting \$281 Million in Estimated “Savings” to the STARS Program

To deploy STARS at an acquisition baseline cost of \$1.69 billion, the program office is counting on future cost “savings” of \$281 million that are not attainable, but program officials have deducted this amount from the STARS cost estimate of \$1.97 billion. While we support the program’s efforts to avoid further cost growth on STARS, program officials are premature in counting these “savings” because:

- Program officials have not completed sufficient analysis to support the forecasted future “savings,” and
- More than half the “savings” would be achieved by transferring costs from FAA’s Facilities and Equipment budget to the Operations budget.

Further, it is premature to count on any savings until program officials determine that the proposed actions are feasible. For example, program officials plan to save \$35 million by reducing telecommunications costs at some terminal facilities. We found that a technical feasibility study to determine if this can be safely done will not be completed until October 2003. We also found that the program office’s documentation did not support the planned telecommunications “savings.” The program office’s data only identify \$7 million that could be legitimately deducted from the Facilities and Equipment budget. The remaining telecommunications “savings,” if feasible, come from reducing telecommunications operations costs, which are not funded from the Facilities and Equipment budget. See Table 1 for a summary of the program’s projected “savings.”

Table 1. “Savings” Projected by STARS Program Officials

Forecast Efficiencies	“Savings” in Millions
Developing Software In-House	\$32
Freezing Common ARTS Improvements	\$20
Reducing Telecommunications Costs	\$35
Testing STARS In-House	\$5
Production, Engineering and Adaptation Efficiencies	\$42
Transferring Facilities and Equipment Costs to the Operations Budget	\$147
TOTAL	\$281

Also, more than half of the projected “savings,” \$147 million, is from transferring some Facilities and Equipment costs for sustainment, such as fixing and testing software, to the Operations budget. Shifting costs to the Operations budget should not be called cost “savings.” In July 2003, we testified that FAA’s Operations budget is already overburdened and FAA needs to control its spiraling operations cost. At a time when the Operations budget is already stretched, FAA will have a difficult time absorbing \$147 million in additional modernization costs in the Operations budget.

Program Officials Need to Develop and Implement an Effective Process to Manage Contract Costs

Before program officials can produce credible contract cost estimates, they must improve contract oversight and evaluate the accuracy of historical costs. Last year, the contracting officer issued a stop-work order on the STARS contract when anticipated contract spending became unsustainable. Subsequently, FAA conducted an internal assessment of the STARS program and concluded that Government cost estimates for STARS have been unrealistically low or were not prepared. Also, the analysis concluded that:

- Contract management had not been a priority, and
- The program did not have an effective process in place to manage the contract.

In December 2002, after we briefed FAA management on our concerns about the lack of STARS contract oversight, the Agency conducted a follow-up assessment to review the program’s business processes. The assessment team recommended that program officials:

- Develop a process to define, record, and track acquisition cost, schedule and technical baselines.
- Establish a formal program review process.
- Fill critical positions, specifically the business financial manager, contracting officer’s technical representative, and engineering positions.
- Restructure the STARS contract and consider a fixed-price type of financial arrangement.
- Request contract audits of all future proposals.

These are basic management practices that should be implemented to manage any acquisition program. Since February 2003, the program office has taken several steps to improve STARS contract management. For example, program officials are now requesting audits of proposed changes to the contract, which should ensure that future contract costs are reasonable. FAA has also appointed a full-time contracting officer's technical representative to oversee activities at the contractor's facility. In our opinion, implementation of these internal recommendations will improve the business practices of the STARS program, but more work needs to be done.

We identified two issues concerning the accuracy of contract cost data that need to be addressed. First, since FAA awarded the prime contract 7 years ago, the program office has never requested an independent audit of the actual costs incurred, which total \$688 million. Without these audits, program officials have no assurance that historical contractor costs are reasonable, applicable to the contract, and allowable by regulation and standards.

Second, the program office has not reconciled STARS expenditures to Raytheon's billings. Our analysis documented a \$41 million discrepancy between the billed contract costs and an internal expenditure report. We compared the contractor's cumulative billings through May 2003, to FAA's obligations and expenditures report. While Raytheon has billed the Government for \$688 million, FAA's latest report showed that only \$647 million had been spent. Management needs complete, current, and accurate information to make informed decisions and avoid serious problems, such as improper payments to the contractor. Without assurance that the contractor's billed costs or FAA's expenditure reports are accurate, the program office cannot provide credible estimates of future contract costs.

In an effort to contain contract costs, STARS program officials are considering a "cost-reimbursable"⁴ structure to price future production options, although the assessment team recommended a fixed-price type of arrangement. If a cost-reimbursable contract is chosen, the program office must use the Defense Contract Audit Agency to review the reasonableness of contract costs and implement better management practices through the life of the STARS contract. As we reported in May 2002, use of cost-reimbursable contracts is more risky for FAA because contractors generally have little incentive to control costs.⁵ Contract negotiations are not expected to be completed until September 2003.

⁴ Typically, cost-reimbursable means that the contractor is awarded an additional fee on top of all costs incurred. This contract type contrasts with a fixed-price type vehicle by which the contractor is paid a predetermined amount for each item and assumes the risk of any future cost increase.

⁵ See [Oversight of Cost-Reimbursable Contracts](#), Report Number FI-2002-092, May 8, 2002.

Independent Cost Assessments for STARS Are Not Complete

Although FAA has two independent assessments of the program's cost estimates underway, neither review is complete. As required by FAA policy, the Agency's investment analysis organization is reviewing the validity of STARS cost estimates. This analysis should be completed before the program office presents its request for rebaselining to senior decisionmakers. As of July 9, 2003, the investment analysis organization had received only draft material from the STARS program office. Until they receive final cost and benefit estimates, they will be unable to complete a thorough evaluation of the STARS revised cost baseline.

In April 2003, FAA commissioned the MITRE Corporation to review STARS program office cost estimates.⁶ According to a MITRE official, the scope of this review is limited to formulating a "best judgment" that the program's cost and schedule estimates will be met and quantifying the amount of risk in the estimates. The review will not involve an independent cost analysis of the program. MITRE's review is expected to be completed in the near future. Without the results of these cost assessments, FAA would be premature in making further decisions on its terminal strategy.

Program Officials Have Not Determined What Capabilities Need to Be Added to STARS and at What Cost

FAA has historically underestimated the development costs for STARS. Since 1996, Congress has provided \$1.16 billion or over 95 percent of the funds FAA requested for STARS (see Exhibit B). However, most of this funding was spent on developing STARS, not delivering new systems. According to FAA's STARS budget requests, the Agency procured only 21 percent of the systems it planned to buy through 2003.

In our opinion, FAA's problems are largely the result of poor cost estimating. In September 2001, FAA testified before the Congress that STARS development was complete.⁷ Nevertheless, over the past 2 fiscal years, FAA has spent more than \$170 million on STARS development, including a significant amount of work to correct problems found during operational testing of the system now commissioned in Philadelphia. In our opinion, the cost of developing STARS will continue to increase as the program office and Raytheon add enhancements to STARS that are already in Common ARTS. FAA has been operating Common

⁶ MITRE is a federally funded research and development center under annual contract to FAA and other Federal agencies to conduct high level analyses.

⁷ FAA testimony before the House Committee on Transportation and Infrastructure, Subcommittee on Aviation, September 13, 2001.

ARTS in the National Airspace System for over 5 years, and the system has been steadily enhanced to respond to new requirements from FAA's users.

Although FAA has commissioned STARS at Philadelphia, STARS is still not ready for deployment at FAA's largest sites, such as Denver and Chicago. In April 2003, the STARS program office conducted a "functionality gap analysis" comparing the capabilities of STARS and Common ARTS. From the analysis, the program office identified at least 50 functions that need to be developed for STARS if it is to be comparable to the Common ARTS in use. The number of new STARS functions may exceed 90. According to program officials, up to half of these functions can be easily resolved. An example of an important function that STARS needs to develop is "radar gateway." In Common ARTS, if the entire computer system fails, radar gateway allows Common ARTS to continue to display radar data to the air traffic controllers. The program office needs to determine which capabilities must be added to STARS and develop cost estimates to add these enhancements.

FAA officials maintain that STARS has unique capabilities that do not exist in Common ARTS. We have not seen sufficient evidence to justify FAA's conclusion that the capabilities of STARS are far superior to the capabilities of Common ARTS, and both systems have been certified for use in the National Airspace System. For instance, although program officials cite enhanced system security as a benefit of STARS, FAA's Information Security Office has determined that both systems are acceptable and have a moderate risk rating. Program officials also identify the addition of manual control knobs for the STARS display as an example of a feature that makes STARS more desirable than Common ARTS. However, FAA has successfully fielded hundreds of color displays without manual knobs at six large terminal locations (Atlanta, Dallas, Potomac, New York, Northern California, and Southern California).

FAA Is Not Considering Reasonable Alternatives to Complete the Terminal Strategy

STARS program officials are planning to request a new cost baseline without considering reasonable alternatives to deploying STARS at all terminal facilities. By considering only STARS, FAA cannot ensure it is selecting the most cost-effective and affordable way to complete terminal modernization. Common ARTS, when upgraded with color displays, satisfies the Agency's terminal modernization requirements and provides the necessary platform to support future capacity-enhancing technologies. One of FAA's largest Common ARTS facilities, Potomac (in Warrenton, Virginia), just began full operations in December 2002 with all new Common ARTS hardware, software, and color displays. Since FAA

has invested \$11 million for Common ARTS at this new facility, we believe that FAA needs to justify why it would be cost-effective and beneficial to replace Common ARTS with STARS.

STARS is not the same program that was planned 8 years ago, and the cost estimates and benefits that supported the initial acquisition strategy are no longer valid. In 1999, as required by FAA policy, FAA's investment analysis organization compared the life-cycle cost benefits of investing in STARS to the life-cycle cost benefits of investing in an alternative (Common ARTS).⁸ FAA's investment analysts found that the effect of FAA's decision to invest in Common ARTS "severely eroded the cost savings/avoidance once attributed to STARS." This means that deploying Common ARTS to replace old systems significantly reduced the benefits of investing in STARS. FAA's investment analysts concluded the benefits of investing in STARS had declined to the point where it would break even when compared with an investment in Common ARTS.

In 1999, the program office estimated life-cycle costs for STARS would be about \$4.1 billion, and Common ARTS was not yet widely deployed at that time. In March 2002, the program office estimated STARS life-cycle costs would exceed \$6.1 billion, and deploying STARS to all terminal locations may no longer be cost-effective. Common ARTS is already deployed at more than 75 percent of FAA's terminal facilities. As shown in Table 2, the program office's latest estimate for STARS life-cycle costs has increased by more than 100 percent since 1996.

**Table 2. Changes in STARS Life-Cycle Cost Estimates
(cost in millions)**

	1996 Baseline	October 1999 Estimate	March 2002 Estimate	Cost Growth	Percent Cost Increase (1996-2002)
Development and Production	\$940	\$1,403	\$1,690	\$ 750	80%
Operations and Maintenance	\$1,296	\$1,816	\$3,057	\$1,761	136%
Technology Refresh	\$640	\$ 948	\$1,359	\$ 719	112%
Total Life-Cycle Costs	\$2,876	\$4,167	\$6,106	\$3,230	112%

Source: FAA estimates

⁸ FAA's policy requires that updated acquisition cost estimates and benefit analyses be developed whenever a revised cost baseline is proposed.

Without a new benefit analysis using updated cost data comparing the benefit of acquiring STARS for all terminal locations with the benefit of retaining existing Common ARTS at some locations, FAA cannot know if its terminal modernization strategy is cost beneficial.

In March and July 2001, due to concerns that STARS acquisition cost estimates were still growing, we recommended that FAA quantify all costs associated with delivery, installation, and testing of STARS, and evaluate if additional Common ARTS with color displays would be needed to support FAA's terminal automation needs. Further, we recommended that this analysis should include an independent assessment by an organization that would not have a vested interest in the outcome. FAA did not implement our recommendations in 2001, but is now in the process of quantifying STARS costs and having them independently assessed. However, the Agency is not considering if additional Common ARTS are needed.

In March 2002, STARS program officials proposed a revised acquisition cost baseline but did not update the benefits analysis. FAA senior decisionmakers directed the program office to obtain an updated benefits analysis before they would approve a baseline change. Subsequently, FAA's investment analysis organization evaluated the economic merits of STARS, comparing the estimated life-cycle costs of STARS to Common ARTS. Common ARTS is a modern automation system that should not be confused with ARTS, a 1970s era system. FAA deployed Common ARTS hardware and software to 141 terminal facilities over the past 5 years at a cost of \$239 million. At the 10 largest facilities using Common ARTS, air traffic controllers supported more than 14 million flight operations last year.

FAA's economic analysis showed that the Agency could save more than \$300 million by limiting STARS to 73 terminal sites and retaining Common ARTS at about 100 locations. Although the assumptions supporting this analysis need to be updated due to additional STARS cost growth, these results show that retaining some Common ARTS sites could be a more cost-effective and beneficial strategy.

To evaluate whether retaining Common ARTS at some sites presents a potentially beneficial alternative to deploying STARS at all locations, we collected rough order of magnitude cost estimates from the STARS program office.⁹ We compared the program's current estimate for acquiring STARS for all sites to cost estimates for two scenarios that involve limiting STARS purchases and retaining significant numbers of Common ARTS. In our scenarios, we included the cost of installing color displays at many Common ARTS sites, since they currently have

⁹ Our purpose was to determine if a viable alternative to an all-STARS solution exists, not to demonstrate a precise dollar amount of savings. We did not validate the accuracy of FAA's estimates.

aging displays. We used the cost of adding ARTS Color Displays to Common ARTS where needed because this is a proven solution.¹⁰ The program office is currently studying the feasibility of adding STARS color displays to Common ARTS.

Specifically, we compared the program office’s plan to deploy STARS to all sites with the rough cost estimates to deploy STARS to only 73 sites, while retaining Common ARTS with color displays at the remaining locations. Also, we compared the program’s cost estimate to only deploy STARS at 47 facilities still equipped with 1970s-era systems, while retaining Common ARTS with color displays at the remaining facilities. Table 3 provides a summary of our analysis of FAA’s estimates.

Table 3. Cost Estimates to Finish Terminal Modernization for Three Scenarios (in millions)

Scenarios	Additional STARS Development/Deployment Cost	Cost of Color Displays for Common ARTS	Total Future Costs	Estimated Savings
Deploy STARS at all sites	\$673	\$0	\$673	\$0
Deploy 73 STARS and upgrade remaining Common ARTS	\$268	\$184	\$452	\$221
Deploy 47 STARS and upgrade remaining Common ARTS	\$189	\$216	\$405	\$268

Source: Office of Inspector General analysis based on FAA cost estimates as of March 10, 2003.

Our analysis found that FAA could save from \$221 million to \$268 million in reduced STARS development and deployment costs by retaining Common ARTS at some sites and adding color displays. These scenarios assume that FAA achieves its proposed \$1.69 billion baseline. If the projected “savings” to support its proposed baseline do not materialize, implementing one of these alternative scenarios could generate up to \$281 million more in savings than those shown in Table 3.

¹⁰ Common ARTS sites with ARTS color displays are Atlanta, Dallas, Louisville, New York, Northern California, Potomac, and Southern California.

Before FAA makes any additional decisions about STARS procurement, program officials should obtain independent cost estimates and benefits analyses for all reasonable alternatives to full STARS deployment. Further, FAA should select the most cost-effective and affordable strategy to complete terminal modernization that would put at least \$221 million to better use by augmenting STARS deployments with Common ARTS at some locations.

RECOMMENDATIONS

At this time, FAA must make a sound business decision on how to move forward with its terminal strategy. Before procuring any additional terminal systems to complete terminal modernization, we recommend that FAA:

1. Develop credible cost estimates and updated benefits analyses for all reasonable alternatives.
2. Select the most cost-effective and affordable strategy to complete terminal modernization that would put at least \$221 million to better use by augmenting STARS deployments with Common ARTS.
3. Reconcile differences between STARS prime contractor billings and FAA's accounting system.
4. Obtain a cost incurred audit for the STARS contract from the Defense Contract Audit Agency.

AGENCY COMMENTS AND OFFICE OF INSPECTOR GENERAL RESPONSE

On August 21, 2003, FAA provided comments (see Appendix) to our July 28, 2003 draft report. FAA concurred with recommendations 1, 3, and 4, but needs to clarify its response to recommendation 2.

Regarding recommendation 1, FAA agreed to develop credible cost estimates and updated benefits analyses for all reasonable alternatives to complete the terminal modernization. Further, the analyses will be supported by outside cost estimators. FAA intends to implement this recommendation by the end of September 2003. FAA's proposed action is responsive and we consider this recommendation resolved subject to our follow-up procedures. However, we request that FAA provide us the results of its analyses of all reasonable alternatives to complete the terminal modernization program.

FAA's response to recommendation 2 needs clarification. The response does not state whether FAA will select the most cost-effective strategy. Further, FAA stated that the Agency would not comment on our estimated savings until the analyses of all reasonable alternatives were complete. FAA has a significant opportunity to cost-effectively complete the terminal modernization program and save several hundred million dollars in acquisition program costs. We believe that our estimate of \$221 million that could be put to better use is conservative and could be substantially higher if FAA does not achieve its \$281 million in projected "savings." We consider this recommendation unresolved and request that FAA clarify whether the Agency concurs with our recommendation and comment on our cost estimate of funds that could be put to better use.

In response to recommendation 3, FAA concurred with our recommendation to reconcile differences between the STARS prime contractor billings and FAA's accounting system. FAA plans to complete this action by December 31, 2003. FAA's proposed action is responsive and we consider this recommendation resolved subject to our follow-up procedures.

Regarding recommendation 4, FAA agreed to obtain a cost incurred audit for the STARS contract from the Defense Contract Audit Agency. However, FAA did not provide an estimated completion date for the proposed action. We request that FAA provide an estimated completion date for implementing this recommendation.

ACTION REQUIRED

In accordance with Department of Transportation Order 8000.1C, we request that you clarify your response to recommendation 2 and provide a target date for implementing recommendation 4. We would appreciate receiving your comments on this report within 30 calendar days. If you do not concur, please provide an explanation of your position. You may provide alternative courses of action that you believe would resolve the issues presented in this report.

We appreciate the cooperation and assistance provided by your staff during our review. If you have any questions concerning this report, please contact me at (202) 366-1992, or David A. Dobbs, Assistant Inspector General for Aviation Audits, at (202) 366-0500.

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EXHIBIT A. SCOPE AND METHODOLOGY

Our objective was to determine if FAA's terminal automation modernization strategy is affordable. To achieve this objective, we reviewed FAA's budget and strategy for reasonableness and cost-effectiveness. To do this, we evaluated FAA's budget, cost and schedule projections for completing modernization, costs incurred to date for STARS and Common ARTS, and alternatives to meet terminal modernization needs. We examined FAA's prior expenditures for STARS and Common ARTS, and compared those actual costs to FAA's earlier cost estimates for the two systems. We applied the outcome of this evaluation to FAA's current projected costs for further terminal modernization to determine if the current projections are reasonable. Once we understood FAA's projected costs, we evaluated terminal modernization options to determine cost-effectiveness.

To perform this review, we obtained billed contract cost data, budget data, acquisition plans, cost and schedule projections, contractor financial and performance reports, and other supporting documentation. We interviewed key FAA and contractor officials responsible for managing the acquisition of STARS and Common ARTS. We performed this audit at FAA Headquarters in Washington, D.C., and the FAA Technical Center in Atlantic City, New Jersey.

EXHIBIT B. STARS FUNDING AND PROCUREMENTS

Fiscal Year	Terminal Automation Budget Request	Actual Appropriation	STARS Procured (Planned)	STARS Procured (Actual)
1996	\$55	\$49		
1997	\$78	\$64	3	
1998	\$108	\$105	5	
1999	\$210	\$199	25	2
2000	\$195	\$195	51	
2001	\$190	\$192	11	12
2002	\$203	\$201	18	18
2003	\$166	\$155	39	0
Total	\$1,206*	\$1,160	152	32**

Source: FAA Budget Submissions to Congress

* Variation due to rounding

** Four STARS sites are operational. Eleven sites have the Early Display Configuration that uses STARS displays with 1970s ARTS computers and software. Seventeen systems are bought, but not installed.

The above table shows that since 1996 Congress has provided about \$1.16 billion for STARS, or more than 95 percent of FAA's funding requests. Most of the funds that FAA requested for the procurement of STARS have actually been spent on unanticipated STARS development. For example, in fiscal year 2003, FAA reduced its planned STARS deployments from 18 to 3 sites and cut new system buys from 39 to zero in order to pay for the costs to deploy STARS to Philadelphia, operational software fixes, and sustainment costs. In total, FAA has only procured STARS for 32 locations, or 21 percent of the systems it planned to buy.

APPENDIX. MANAGEMENT COMMENTS



U.S. Department
of Transportation
**Federal Aviation
Administration**

Memorandum

Subject: **INFORMATION:** Draft Report: FAA Needs to
Reevaluate STARS Costs and Consider Other
Alternatives

Date: **AUG 2 | 2003**

From: Acting Assistant Administrator for Financial
Services and Chief Financial Officer

Reply to
Attn. of:

To: Assistant Inspector General for Aviation Audits

As requested in your memorandum dated July 28, we have reviewed the subject report. We concur with recommendations 1,3, and 4 and partially concur with recommendation 2. The following is our response to each recommendation.

1. **OIG Recommendation:** Develop credible cost estimates and updated benefits analyses for all reasonable alternatives.

FAA Response: Concur. The Standard Terminal Automation Replacement System (STARS) Program is generating an independent government cost estimate for the remainder of the program. The estimate employs the Federal Aviation Administration's (FAA) work breakdown structure and is consistent with agency policies and guidelines. The team developing the estimate is supported by outside professional cost estimators used throughout the agency. The cost estimates and benefits analyses for the program of record and all reasonable alternatives will be credible and valid and will be presented at the Joint Resource Council (JRC) in September.

2. **OIG Recommendation:** Select the most cost-effective and affordable strategy to complete terminal modernization that would put at least \$221 million to better use by augmenting STARS deployments with Common Automated Radar Terminal System.

FAA Response: Partially concur. The JRC has directed the STARS program office to develop cost estimates for reasonable alternatives to STARS, which are presently under development. These alternatives will be presented with life cycle costs at the September JRC in conjunction with the program of record. Until the analysis is complete, the agency has no comment on the \$221 million savings identified in the report.

2

3. **OIG Recommendation:** Reconcile differences between STARS prime contractor billings and FAA's accounting system.

FAA Response: Concur. We anticipate completing the reconciliation by December 31.

4. **OIG Recommendation:** Obtain a cost incurred audit for the STARS contract from the Defense Contract Audit Agency (DCAA).

FAA Response: Concur. The agency is currently working with DCAA to schedule the audit and to prepare a timeline for its completion. This information will be provided as soon as it is available.

We appreciate the opportunity to comment on this report. Should you have questions or need further information, please contact Anthony Williams, Budget Policy Division, ABU-100. He can be reached at (202) 267-9000.


John F. Hennigan