

Mr. Chairman and Members of the Subcommittee:

We appreciate the opportunity to update you on the Federal Aviation Administration's (FAA) efforts to develop and deploy the Standard Terminal Automation Replacement System (STARS). STARS will provide air traffic controllers in the terminal environment with color displays, processors, and computer software at over 170 FAA and 100 Department of Defense (DOD) facilities. STARS is the platform to which a range of capacity-enhancing technologies, such as new automated controller tools and data link communications, will be added. FAA currently estimates total STARS program costs at \$1.57 billion.

To better manage software development, FAA fragmented the STARS development and testing plan into multiple configurations using a "building block" approach. As a result, STARS is separated into unique versions, with each version building on the previous one. The versions currently being tested or about to be tested include Full STARS Version 1, Full STARS Version 2, and Full STARS Version 2 plus (the completed system that will be deployed nationally).

In June of this year, we testified before this Subcommittee that deploying STARS within cost and schedule remained at risk due to an aggressive test schedule and dependencies on the ASR-11 digital radar deployment. FAA is purchasing the digital ASR-11 radar through a DOD contract to replace its aging analog terminal radar. We also testified that FAA needed to evaluate if additional Common ARTS (a system with capabilities similar to STARS) will be needed to support FAA's terminal modernization efforts should STARS fall further behind schedule. Today, I would like to discuss three points concerning STARS deployment.

- First, the risks of deploying STARS on schedule have increased since we testified in June. Additional problems were uncovered during software re-testing of Full STARS Version 1. FAA does not plan to adjust the STARS deployment schedule to allow additional time for further testing and, instead, has developed, in our opinion, a riskier plan to test all versions of STARS simultaneously.
- Second, the ASR-11 program continues to pose a risk to STARS. DOD testing of the system identified serious problems with the system including misleading weather data and false targets. As a result, DOD postponed its decision to enter into full production of the radar until September 2002. However, to ensure that future STARS sites have digital radar on time, FAA will have to decide whether to procure additional ASR-11 radars in December of this year.

- Lastly, in our prior testimonies, we expressed significant concerns over how FAA would mitigate risks to the nation's busiest airports should STARS deployment be further delayed. One location – Philadelphia – has now become critical and could seriously impact airspace across the East Coast if STARS is not fully operational at that location by February 2003.

**FAA's Decision to Simultaneously Test Multiple Versions of STARS Increases Risks to the STARS Deployment Schedule.** In June, we testified that a key milestone for measuring progress of the STARS program would be successful re-testing in mid-July of software for Full STARS Version 1. Because of the “building block” approach used in STARS, unsuccessful completion of Version 1 testing would impact testing of later versions. FAA first tested Full STARS Version 1 software in May of this year and identified over 500 trouble reports -- 189 of those reports were considered critical; that is they had to be corrected before STARS could be re-tested.

FAA conducted the re-test between July 20 and August 3, and identified 107 new problems. As of September 5, FAA had a total of 355 trouble reports, of which 104 were critical. A significant concern to us is that the proportion of critical trouble reports to total reports has remained fairly constant with each test indicating that new critical problems are appearing as quickly as other ones are being corrected. These problems were so serious that FAA was forced to allow Raytheon additional time to resolve the deficiencies before testing could resume. As a result, the next phase of testing for Full STARS Version 1 software has now slipped an additional 3 months.

FAA has not, however, adjusted the STARS deployment date to allow for additional testing. Instead, to compensate for the slippage while maintaining the existing deployment schedule, FAA modified its testing plans by developing a strategy for testing the multiple versions of STARS simultaneously. This simultaneous testing strategy means that later versions of STARS will be tested using software that has failed earlier tests and has significant known deficiencies.

During simultaneous testing, FAA plans to insert fixes to Full STARS Version 1 software as they are completed by Raytheon. However, FAA's testing plan does not require all fixes to Version 1 software to be completed until July 2002 -- only 3 months prior to the scheduled deployment date at the first site. During this period, Raytheon will also be testing, repairing, and re-testing Version 2 and Version 2 plus software. This 3-month period allows very little time for site-specific configuration and testing that must be accomplished before STARS can become operational at any location.

In June, we recommended that FAA again task MITRE to analyze Raytheon's ability to complete STARS testing given the large number of trouble reports. MITRE determined that the existing schedule is achievable despite the large number of trouble reports. However, MITRE noted that Raytheon would need to accelerate its pace of resolving trouble reports and that additional resources would likely be needed to meet the existing schedule. MITRE also noted that resources may be further strained if a greater than expected number of trouble reports are generated or if requirements changes are needed.

**The ASR-11 Program Continues to Pose a Major Risk to STARS Deployment.**

The ASR-11 radar program continues to pose a major risk to STARS deployment. STARS requires a digital radar system. However, with the exception of Philadelphia, the first sites that do not already have a digital radar are not scheduled to receive STARS until 2005. The ASR-11 radar is a digital system that will replace aging analog radar systems at those locations. FAA is planning to purchase 112 ASR-11 radars at a current cost of \$889 million or \$7.9 million per radar, through a DOD contract. Each ASR-11 radar unit requires a 3-year lead-time from procurement to site operational capability.

The ASR-11 system has been experiencing significant problems. Currently, the ASR-11 is 2 years behind schedule and \$146 million over budget. In April of this year, DOD testing of the ASR-11 identified significant deficiencies in the system including false aircraft targets being displayed and misleading weather detection and display. As a result, DOD has delayed a full production decision until Raytheon can demonstrate that the deficiencies have been corrected. DOD will resume testing in March 2002 and plans to make a decision on full production for the ASR-11 radar in September 2002.

FAA will need to make a similar decision about the ASR-11 system and is currently conducting its own tests on the system to determine if the deficiencies have been corrected. However, to ensure that future STARS sites have digital radar on time, FAA will have to make that purchase decision before DOD's final decision about full production because of the long lead-time needed to procure ASR-11 radars.

This December will be a key date because FAA will need to verify that corrections to the ASR-11 software have been made. At that time, FAA will need to either purchase additional systems or look for acceptable alternatives. FAA has already purchased 21 ASR-11 radars and plans to purchase an additional 14 radars depending on results of its tests. However, FAA will face a significant risk if it elects to purchase additional ASR-11 radars in December and DOD later decides to forgo full production.

The contract for the ASR-11 will also complicate FAA's decision. FAA's ability to purchase from the current ASR-11 contract expires in 2004, which could have significant cost implications for FAA since new negotiations will be required to purchase additional radars beyond 2004.

**FAA Must Determine How to Mitigate Risks Associated with Further Delays in STARS at Key Locations.** As we have testified previously, the STARS test and deployment schedules are extremely aggressive. FAA expects to complete over 170 installations between 2002 and 2008. At the height of deployment, nearly one site per week is scheduled to be delivered. Risks to the STARS deployment schedule have increased as a result of changes to FAA's testing strategy and uncertainties about the ASR-11 radar.

In our prior testimonies before this Subcommittee, we have repeatedly expressed concerns over how FAA would mitigate the risks to the nation's busiest airports should STARS deployment be further delayed. Currently, 15 of the 31 busiest airports in the nation designated by FAA as "benchmark locations," are scheduled to receive STARS between 2002 and 2005. These facilities continue to operate with automation systems built in the 1970's (ARTS IIIA). While the severity of system outages has been low, according to FAA, during the past year Houston, Las Vegas, Memphis, Miami, and Philadelphia (which are all ART IIIA locations) accounted for one third of all ARTS IIIA terminal system failures in the nation.

One location – Philadelphia – has now become critical. FAA estimates that the existing ARTS IIIA technology at Philadelphia will reach its capacity to handle additional aircraft beginning in February 2003. Philadelphia is currently scheduled to become operational with STARS in November 2002, which would leave a margin of only 3 months. If STARS is not in place, and fully functioning at Philadelphia by February 2003, FAA will have to begin restricting the use of Philadelphia's airspace. This would have serious capacity repercussions because Philadelphia's airspace is a major thoroughfare for East Coast traffic.

The risks posed at Philadelphia require the heightened attention of FAA and Congress. In the past, FAA has used Common ARTS as an interim solution for terminal modernization needs at key locations. However, Common ARTS requires an 18-month lead-time from system procurement to operational use at each site. This puts Philadelphia at risk now. It is critical that FAA implement a contingency plan for Philadelphia given the risks associated with any delays in STARS deployment to this location.

## **Background.**

STARS will replace controller workstations with new color displays, processors, and computer software at over 170 FAA and 100 DOD terminal air traffic control facilities.<sup>1</sup> STARS was designed to replace aging equipment and provide the software and hardware platform necessary to support future air traffic control tools in the terminal environment.

FAA fragmented the STARS development plan into multiple configurations to better manage software development. FAA's decision to split the development of STARS using the "*build a little, test a little*" approach resulted in multiple configurations, each requiring its own set of milestones for development and testing. FAA now estimates that the last full service STARS will be deployed to FAA facilities by September 2008 – almost 4 years behind schedule.

FAA has modified the STARS total program cost baseline from \$940 million to \$1.57 billion. FAA also identified costs necessary for STARS implementation through 2004 that were not included in the baseline such as training and facility modernization that will increase the total terminal modernization costs to \$1.678 billion.

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<sup>1</sup> The terminal environment controls aircraft taxiing, or departing from and arriving at airports and consists of both Air Traffic Control Towers and TRACONS at or near airports.

Because of delays in the STARS program, FAA also moved forward with an interim measure, known as Common ARTS. Common ARTS provides many of the same functions that STARS will provide when completed. The Common ARTS standard software package is being used at FAA's highest volume terminal facilities. Since 1998, FAA installed the Common ARTS software upgrade at 6 of the highest traffic sites and 131 low-to-mid-traffic sites. By May 2002, FAA expects to install Common ARTS at four more high traffic facilities while STARS development is being completed and tested.

**FAA's Decision to Simultaneously Test All Versions of STARS Increases**

**Risks to the STARS Deployment Schedule.** In June, we testified that a key milestone for measuring progress on the STARS program would be the successful re-testing in mid-July of software for Full STARS Version 1. Because STARS was developed through a process using multiple configurations, with each configuration building on the previous one, STARS must pass extensive and rigorous testing at each phase of development.

As the following diagram shows, STARS software was designed in a building block manner, with each version -- Full STARS Version 1 (FS-1), Full STARS Version 2 (FS-2) and Full STARS Version 2 plus (FS-2+) -- acting as a baseline for the subsequent version.

For example, Full STARS Version 2 plus (the nationally deployable version) will build upon the software lines of code developed for both Full STARS Versions 1 and 2. Because of this “building block” approach, unresolved problems identified in one version impact testing of later versions.

<b>BUILDING BLOCKS for STARS</b> <b>Software Lines of Code (SLOC)</b>		
		<b>FS-2+</b> <b>15,000 SLOC</b>
	<b>FS-2</b> <b>56,300 SLOC</b>	<b>FS-2</b> <b>56,300 SLOC</b>
<b>FS-1</b> <b>109,500 SLOC</b>	<b>FS-1</b> <b>109,500 SLOC</b>	<b>FS-1</b> <b>109,500 SLOC</b>

FAA first tested Full STARS Version 1 software in May of this year and identified over 500 trouble reports -- 189 of those reports were considered critical (that is they had to be corrected before STARS could be re-tested). FAA conducted the re-test between July 20 and August 3 and found 107 new problems. As the following chart shows, as of September 5, 2001, Full STARS Version 1 still had 104 critical trouble reports which must be fixed before another re-test.

<b>Open Trouble Reports for Full STARS Version 1</b>			
<b>Date</b>	<b>Critical Trouble Reports</b>	<b>All Other Trouble Reports</b>	<b>Total</b>
May 25, 2001	189	335	524
August 9, 2001	121	200	321
September 5, 2001	104	251	355

A significant concern to us is that the proportion of critical trouble reports to total reports has remained fairly constant with each test indicating that new critical problems are appearing as quickly as other ones are being corrected.

*FAA Has Modified Its Test Strategy as a Result of the Re-Test.* FAA recognized that more time than currently allotted in the test schedule would be needed to fix the critical problems and verify the corrections before further testing Version 1 software. As a result, FAA delayed the start of the next test phase of Full STARS Version 1 by 3 months – a total of 5 months since the original date set in February.

However, FAA did not substantially change the testing period for the subsequent versions due to concerns that further delays in testing would cause significant delays to the deployment schedule. To maintain the same test schedule for the subsequent versions, FAA decided to modify its testing plans by developing a strategy for testing multiple versions of STARS simultaneously, as well as compressing the time allowed for some key tests. The following two charts provide information on the STARS test schedule as of May 2001 and the revised test schedule as of September 2001. The test stages listed in the charts are System



Acceptance Testing (SAT) -- contractor's demonstration of technical performance, and Operational Test and Evaluation (OT&E) -- FAA's tests to determine if the system is operationally suitable and effective.

STARS TEST SCHEDULE MAY 2001																							
Task Name	2001												2002										
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug			
FS-1 SAT																							
FS-1 OT & E																							
FS-2 SAT																							
FS-2+ SAT																							
FS-2/FS-2+ OT&E																							

STARS TEST SCHEDULE SEPTEMBER 2001																							
Task Name	2001												2002										
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug			
FS-1 SAT																							
FS-1 OT & E																							
FS-2 SAT																							
FS-2+ SAT																							
FS-2/FS-2+ OT&E																							

According to the May 2001 test schedule, the current acceptance test phase for Full STARS Version 1 was to be completed by the end of July 2001. As shown in the September 2001 test schedule, this testing has been extended through November 2001 and now overlaps the beginning of Full STARS Version 2 acceptance testing.

This constitutes a major change to FAA's test strategy and creates additional risk for the schedule by compressing an already aggressive test schedule into a much shorter timeframe. Key test personnel and physical assets are being forced to conduct the same amount of testing in a much shorter period, and any loss of people or assets now has a larger chance of adversely impacting the schedule.

During simultaneous testing, FAA plans to insert fixes to Full STARS Version 1 software as they are completed by Raytheon. However, FAA's testing plan does not require all fixes to be completed until July 2002 -- only 3 months prior to the scheduled deployment date at the first site. This 3-month period allows very little time for site-specific configuration and testing that must be accomplished before STARS can become operational at any location.

***MITRE Revalidated Its Review of Raytheon.*** In June, we recommended that FAA again task MITRE to analyze Raytheon's ability to complete STARS testing given the large number of trouble reports. MITRE determined that the existing

schedule is achievable despite the large number of trouble reports. However, MITRE noted that Raytheon would need to accelerate its pace of resolving trouble reports and that additional resources would likely be needed to meet the existing schedule. MITRE also noted that resources may be further strained if a greater than expected number of trouble reports are generated or if requirements changes are needed.

**The ASR-11 Program Continues to Pose a Major Risk to STARS**

**Deployment.** The ASR-11 radar program continues to pose a major, although later risk to STARS deployment. STARS requires a digital radar system. However, with the exception of Philadelphia, the first sites that do not already have a digital radar are not scheduled to receive STARS until 2005. The ASR-11 radar is a digital system that will replace aging analog radar systems at those locations. FAA is planning to purchase 112 ASR-11 radars at a current cost of \$889 million or \$7.9 million per radar, through a DOD contract. Each ASR-11 radar unit requires a 3-year lead-time from procurement to site operational capability.

The ASR-11 system has been experiencing significant problems. Currently, the ASR-11 is 2 years behind schedule and \$146 million over budget. In April of this year, DOD testing of the ASR-11 identified significant deficiencies in the system including false aircraft targets being displayed and misleading weather detection

and display. As a result, DOD has delayed a full production decision until Raytheon can demonstrate that the deficiencies have been corrected. DOD will resume testing in March 2002 and plans to make a decision on full production for the ASR-11 radar in September 2002. FAA will need to make a similar decision about the ASR-11 system and is currently conducting its own tests on the system to determine if the deficiencies have been corrected. However, to maintain the existing deployment schedule, FAA will have to make that purchase decision before DOD's final decision about full production because of the long lead time needed to procure ASR-11 radars.

This December will be a key date because FAA will need to verify that corrections to the ASR-11 software have been made. At that time, FAA will need to either purchase additional systems or look for acceptable alternatives. FAA has already purchased 21 ASR-11 radars and plans to purchase an additional 14 radars depending on results of its tests. However, FAA will face a significant risk if it elects to purchase additional ASR-11 radars in December and DOD later decides to forgo full production. The contract for the ASR-11 will also complicate FAA's decision. FAA's ability to purchase from the current ASR-11 contract expires in 2004, which could have significant cost implications for FAA since new negotiations will be required to purchase additional radars beyond 2004.

With the uncertainties of the ASR-11 program, FAA is moving forward with a contingency plan to purchase digitizers that can convert analog radar signals of ASR-7 and ASR-8 radar systems to digital signals to work with STARS. FAA is evaluating whether digitizers could be an effective “stopgap” measure until the ASR-11 digital radars are deployable. However, digitizers would require extensive operational testing before being used with STARS, and FAA has not developed a test plan using that scenario. In addition, digitizers are expensive, at over \$1 million per system. As of today, it is unclear who will pay for digitizers needed while Raytheon works to fix problem with the ASR-11.

**FAA Needs to Implement an Interim Plan to Mitigate Risks Associated with Potential Delays in STARS Deployment.** As we have testified previously, the STARS test and deployment schedules are extremely aggressive. FAA expects to complete over 170 installations between 2002 and 2008. At the height of deployment, nearly one site per week is scheduled to be delivered. Risks to the STARS deployment schedule have increased as a result of changes to FAA’s testing strategy and uncertainties about the ASR-11 radar.

In our prior testimonies before this Subcommittee, we have repeatedly expressed concerns over how FAA would mitigate the risks to the nation’s busiest airports should STARS deployment be further delayed. As shown in the following table,

currently, 15 of the 31 busiest airports in the nation designated by FAA as “benchmark locations,” are scheduled to receive STARS between 2002 and 2005.

**Fifteen of the Busiest Airports Served with Aging ARTS IIIA Equipment**

Currently Serviced by ARTS IIIA Equipment	Scheduled Deployment of STARS
Detroit	June 2002*
Las Vegas	October 2002*
Memphis	October 2002
Philadelphia	November 2002
Boston	June 2003
Miami	July 2003
Seattle	November 2003
Orlando	March 2004
Salt Lake City	May 2004
Pittsburgh	May 2004
Cincinnati	June 2004
Phoenix	June 2004
Charlotte	July 2004
Tampa	September 2004
Houston	April 2005

\*This data reflects when the site is scheduled to receive the STARS Early Display Configuration (EDC), not Full STARS. EDC continues to rely on the existing ART IIIA software and hardware to operate. FAA has not scheduled when it will install Full STARS at these sites.

These facilities continue to operate with automation systems built in the 1970’s (ARTS IIIA). While the severity of system outages has been low, according to FAA, during the past year Houston, Las Vegas, Memphis, Miami, and Philadelphia (which are all ART IIIA locations) accounted for one third of all ARTS IIIA terminal system failures in the nation.

Of immediate concern is Philadelphia. FAA estimates that the existing ARTS IIIA technology at Philadelphia will reach its capacity to handle additional aircraft beginning in February 2003. Philadelphia is currently scheduled to become operational with STARS in November 2002, which would leave a margin of only 3 months.

If STARS is not in place, and fully functioning in Philadelphia by February 2003, FAA will have to begin restricting the use of Philadelphia's airspace. This would have major capacity repercussions because Philadelphia's airspace is a major thoroughfare for East Coast traffic.

The risks posed at Philadelphia require the heightened attention of FAA and Congress. In the past, FAA has used Common ARTS as an interim solution for terminal modernization needs at key locations. However, Common ARTS requires an 18-month lead-time from system procurement to operational use at each site. This puts Philadelphia at risk now. It is critical that FAA implement a contingency plan for Philadelphia given the risks associated with any delays in STARS deployment to this location.

Mr. Chairman, this concludes my statement. I would be pleased to answer any questions.