# OPERATIONAL ERRORS AND RUNWAY INCURSIONS: PROGRESS MADE, BUT THE NUMBER OF INCIDENTS IS STILL HIGH AND PRESENTS SERIOUS SAFETY RISKS

*Federal Aviation Administration*

*Report Number: AV-2003-040*
*Date Issued:  April 3, 2003*

![U.S. Department of Transportation logo]

**U.S. Department of
Transportation**
Office of the Secretary
of Transportation
Office of Inspector General

# Memorandum

Subject: <u>ACTION</u>: Report on Operational Errors and
Runway Incursions: Progress Made, but the
Number of Incidents Is Still High and Presents
Serious Safety Risks
AV-2003-040

Date: April 3, 2003

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

Reply to
Attn. of: JA-10

To: Federal Aviation Administrator

This report presents the results of our review of the Federal Aviation Administration's (FAA) progress in reducing operational errors and runway incursions. An executive summary of the report follows this memorandum. The objective of this audit was to determine whether FAA is making progress in reducing operational errors and runway incursions.

After several years of continuous increases in operational errors and runway incursions, FAA has made progress in reducing these incidents. In fiscal year (FY) 2002, operational errors decreased 11 percent to 1,061 and runway incursions decreased 17 percent to 339 from FY 2001 levels. Despite FAA's progress, the number of these incidents is still too high considering the potential catastrophic results of a midair collision or a runway accident. In FY 2002, on average, one runway incursion and three operational errors occurred each day. Further, the most serious runway incursions (those rated in the two high risk categories) occurred, on average, once every 10 days; and the most serious operational errors (those rated as high risk) occurred, on average, once every 8 days. On average, in FY 2002, at least one commercial aircraft was involved in a serious runway incursion or operational error once every 10 days.

It is important that FAA take additional actions to further reduce the number and safety risk of operational errors and runway incursions, especially since FAA projects that air traffic operations will return to pre-September 11th growth patterns between 2005 and 2007.

Our recommendations focused on the specific actions FAA needs to take to further reduce operational errors and runway incursions. Recommended actions include:

- improving oversight of regions and facilities that do not show progress in reducing operational errors;
- implementing its human factors initiative for memory enhancement training for controllers;
- reexamining and expanding the severity classification for the most serious operational errors;
- implementing mandatory training requirements for controllers who make multiple operational errors or moderate and high rated operational errors;
- evaluating the impact the expanded Controller-in-Charge (CIC) Program has had on operational errors on a facility-by-facility basis; and
- implementing recommendations from its technological reviews completed at 13 airports that had 10 or more runway incursions between 1997 and 2000.

On March 21, 2003, FAA provided written comments (attached as an Appendix to this report) to our February 26, 2003 draft report. Regarding our recommendations for operational errors, FAA agreed with our recommendation to improve its national oversight of the regions and facilities that do not show progress at reducing operational errors, and indicated that these actions will be completed by May 1, 2003. FAA also agreed with our recommendation to implement its human factors initiative for memory enhancement training, but FAA needs to provide a target date for implementation.

On March 28, 2003, FAA provided revised comments to address our recommendations to revise training requirements for operational errors. FAA officials stated that they are currently involved in a review of existing Memorandums of Understanding (MOU), which includes re-examining the provisions of the MOU on training requirements for operational errors. We consider FAA's proposed actions to be responsive to these recommendations and will monitor FAA's progress in this area.

However, FAA's proposed actions regarding our recommendations on expanding its severity rating system for serious operational errors, and monitoring the impact of the expanded CIC Program on operational errors, do not fully address the intent of our recommendations and are not responsive. Therefore, we are requesting that FAA reconsider its response.

First, FAA did not indicate whether it planned to expand its severity rating system for operational errors. This is important because some operational errors rated as moderate are a very serious safety risk. For example, one operational error rated as moderate involved two commercial airliners, approaching head-on at a closure

rate of 460 miles per hour; they were less than 12 seconds from a midair collision when they took evasive action. FAA needs to accurately identify all serious operational errors to ensure that it focuses resources on reducing the most dangerous operational errors.

Second, FAA did not specify actions it planned to take to monitor the impact of the expanded CIC Program on operational errors. The CIC Program was expanded as a result of a 1998 agreement between FAA and the National Air Traffic Controllers Association to reduce the number of air traffic control supervisors by about one-third. To offset the reduction of supervisors, FAA agreed to use CICs to provide oversight of air traffic operations during the absence of supervisors. FAA agreed with our recommendation and stated that it will include the program in its causative analysis efforts, but it is unclear whether these efforts will include monitoring the impact of the expanded CIC Program on operational errors. From calendar year (CY) 2000 to CY 2001, operational errors that occurred while a CIC was on duty increased 46 percent. Until FAA conducts detailed evaluations of those facilities that have significant increases in operational errors while CICs are on duty, the reasons for the increases will not be known and FAA's ability to make additional progress in reducing operational errors will be hindered.

In addition to the recommendations made in our draft report, we are making a new recommendation for FAA to identify and monitor statistics on the number of operational errors by commercial, general aviation, and military aircraft. This is important in measuring the overall safety impact of operational errors. For example, operational errors that involve commercial aircraft should be identified and monitored because they can place hundreds of passengers at risk.

A complete description of our recommendations regarding operational errors, FAA's comments, and our response can be found on pages 17 through 20 of this report.

Regarding our recommendations concerning runway incursions, FAA agreed to implement recommendations in its Runway Incursion Airport Assessment Report made as a result of technological reviews of 16 problem airports. FAA is working at the field level to coordinate improvements to signs, surface markings, and security made as a result of these recommendations. Of these 16 airports, FAA identified 6 airports for improved airport marking and signs, and it indicated that work at 4 of these airports has been completed. FAA is also working at other airports to test improvements to surface operations. FAA plans to complete this work in 2004 and begin to work at higher capacity commercial and general aviation airports in 2005.

FAA also agreed to conduct technology reviews at 4 airports that had 10 or more runway incursions over the 4-year period 1999 to 2002. FAA indicated the work has already been directed and will be completed in 2003. When fully implemented, these actions should help further reduce runway incursions. Accordingly, we consider FAA's proposed actions to be responsive, and we consider these recommendations resolved.

In accordance with Department of Transportation Order 8000.1C, we request that you reconsider your response regarding our recommendations concerning operational errors, as noted on pages 17 through 20. We further request that you provide specific actions taken or planned, with target dates, to address these recommendations. We also request that you provide comments on the additional recommendation, to identify and monitor statistics on the number of operational errors that involve commercial, general aviation, and military aircraft. For this recommendation, if you concur, please provide the specific action taken or planned and a target date for completion. If you nonconcur, please provide your rationale. You may provide alternative courses of action that you believe would resolve the issues presented in this report. Please provide your response within 30 calendar days.

We appreciate the cooperation and assistance provided by your staff during the audit. If I or my staff can provide you with additional information, please call me on (202) 366-1992 or David A. Dobbs, Assistant Inspector General for Aviation Audits, on (202) 366-0500.

Attachment

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# Executive Summary

## Operational Errors and Runway Incursions: Progress Made, but the Number of Incidents Is Still High and Presents Serious Safety Risks
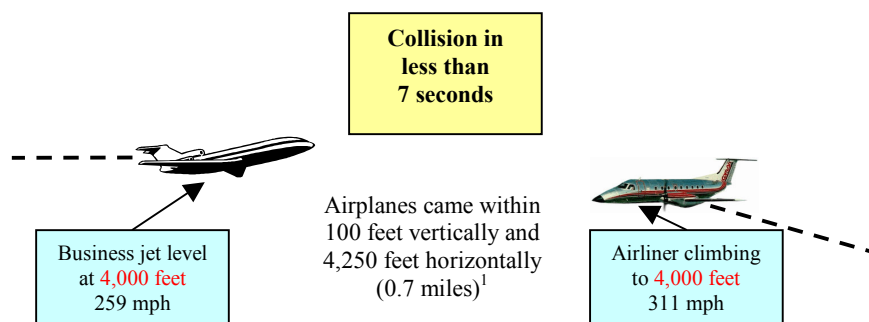
### Federal Aviation Administration

Report No. AV-2003-040                                                     **April 3, 2003**

## BACKGROUND AND OBJECTIVE

Operational errors and runway incursions pose very serious safety risks and are critical safety indicators for the Nation's air traffic control system. An *operational error*[1] occurs when an air traffic controller does not ensure that Federal Aviation Administration (FAA) separation standards are maintained between airplanes. Operational errors occur mostly in the air[2] and can pose a very serious safety risk, as described in the following example. In April 2002, an operational error occurred at the Atlanta Terminal Radar Approach Control (TRACON) when a controller directed a commercial airliner and a business jet onto converging courses. As depicted in Figure 1, the aircraft were about 7 seconds from a midair collision when the pilots' evasive actions averted an accident.

### Figure 1—Operational Error at the Atlanta TRACON



**Collision in less than 7 seconds**

Airplanes came within 100 feet vertically and 4,250 feet horizontally (0.7 miles)[1]

Business jet level at 4,000 feet 259 mph

Airliner climbing to 4,000 feet 311 mph

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[1] Standard separation in the en route environment is 5 nautical miles horizontally and 1,000 feet vertically up to 29,000 feet, and 2,000 feet vertically above 29,000 feet. Horizontal separation in the terminal environment is generally between 3 and 5 nautical miles depending on the type of airplane. All references to miles in this report are nautical miles. A nautical mile is equivalent to 6,076 feet.

[2] Historically, about 90 percent of the reported operational errors occur in the air. Operational errors that occur on the runway and create a collision hazard are considered runway incursions.

In July 2002, a midair collision between a Russian passenger airliner and a Boeing 757 cargo plane occurred over southern Germany at an altitude of about 35,000 feet.  A total of 71 people were killed.  This tragic accident shows just how serious midair collisions can be.  The cause of this accident is currently under investigation by the German authorities.

*Runway incursions*[3] are incidents on the runway that also create a collision hazard. Several major accidents have occurred on the runway.  For example, in October 2001, a McDonnell Douglas MD-80 taking off in poor visibility from Linate Airport in Milan, Italy, struck a Cessna business jet that entered the runway by mistake.  A total of 118 people were killed in that accident.

Although this accident did not occur in the United States, it shows the extent of the safety risk posed by runway incursions.  An incident similar to the one in Milan occurred at the Los Angeles Airport in California in March 2002.  A Boeing 737 aircraft entered an active runway without authorization as a Boeing 757 was taking off.  The two aircraft were separated by only 200 feet vertically.  Since 1990, there have been 9 runway accidents[4] in the United States that claimed 49 lives and damaged 16 aircraft.

The objective of this audit was to determine whether FAA is making progress in reducing operational errors and runway incursions.  Additionally, we determined whether FAA implemented recommendations contained in our previous reports on operational errors and runway incursions.[5]  Our field work primarily focused on operational errors, because these incidents continued to rise in fiscal year (FY) 2001.  The audit was conducted between December 2001 and March 2003.  We conducted the audit in accordance with Government Auditing Standards prescribed by the Comptroller General of the United States.  (See Exhibit A for a list of organizations visited or contacted.)

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[3] FAA defines a runway incursion as any occurrence at an airport involving an aircraft, vehicle, person, or object on the ground, that creates a collision hazard or results in a loss of separation with an aircraft taking off, intending to take off, landing, or intending to land.  FAA's definition applies only to airports with operating air traffic control towers.

[4] These numbers do not include the runway accident that occurred at Quincy, Illinois, in November 1996 that resulted in 14 fatalities.  This accident does not meet FAA's definition of a runway incursion since it occurred at a non-towered airport.

[5] "Actions to Reduce Operational Errors and Deviations Have Not Been Effective" (Report Number AV-2001-011, December 15, 2000), and "Despite Significant Management Focus, Further Actions Are Needed to Reduce Runway Incursions" (Report Number AV-2001-066, June 26, 2001).  See Exhibits E and F, respectively, for the status of recommendations from these reports.
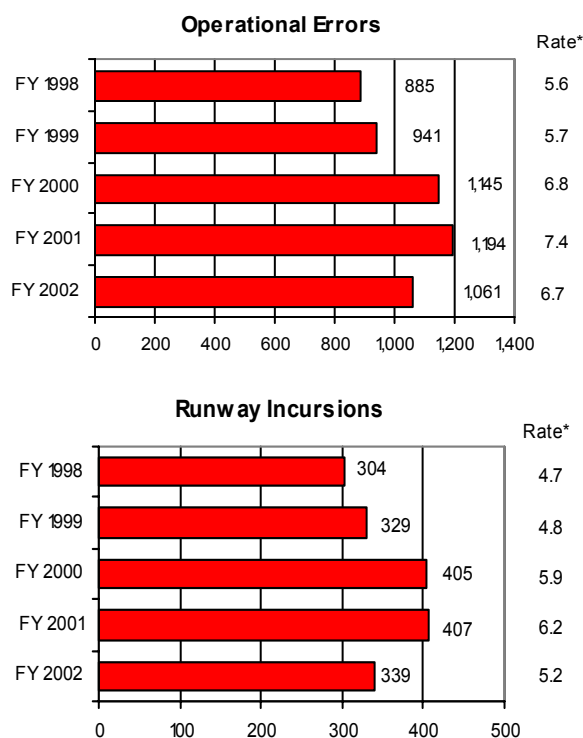
## RESULTS IN BRIEF

After several years of continuous increases in operational errors and runway incursions, FAA has made progress in reducing these incidents in FY 2002, as shown in Figure 2. From FY 1998 through FY 2001, operational errors increased 35 percent—from 885 to 1,194. During this same time period, runway incursions increased 34 percent from 304 to 407. This past year FAA has begun to reverse this trend. In FY 2002, operational errors decreased 11 percent to 1,061 and runway incursions decreased 17 percent to 339 from FY 2001 levels. FAA's success was due in part to the implementation of FAA and industry initiatives. In addition, we found that there was a statistical correlation between the decrease in these incidents and the reduction in air traffic operations.

### Figure 2—Operational Errors and Runway Incursions FY 1998 to FY 2002

**Operational Errors**

| | | Rate* |
|---|---|---|
| FY 1998 | 885 | 5.6 |
| FY 1999 | 941 | 5.7 |
| FY 2000 | 1,145 | 6.8 |
| FY 2001 | 1,194 | 7.4 |
| FY 2002 | 1,061 | 6.7 |

0  200  400  600  800  1,000  1,200  1,400

**Runway Incursions**

| | | Rate* |
|---|---|---|
| FY 1998 | 304 | 4.7 |
| FY 1999 | 329 | 4.8 |
| FY 2000 | 405 | 5.9 |
| FY 2001 | 407 | 6.2 |
| FY 2002 | 339 | 5.2 |

0  100  200  300  400  500

\* Rate is per million air traffic operations. The rate for operational errors includes all air traffic facilities. For runway incursions, the rate includes only tower facilities.

Despite FAA's progress in reducing the number of operational errors and runway incursions in FY 2002, the number of these incidents is still too high considering the potential catastrophic results of a midair collision or a runway accident. Reducing runway incursions has remained on the National Transportation Safety Board's (NTSB) annual "Most Wanted" list of transportation safety improvements since 1990.

In FY 2002, on average, three operational errors and one runway incursion occurred each day. The most serious runway incursions (those rated in the two high risk categories) occurred, on average, once every 10 days. FAA records showed that the most serious operational errors (those rated as high risk) occurred, on average, once every 8 days. On average, in FY 2002, at least one commercial aircraft was involved in a serious runway incursion or operational error once every 10 days.

In our opinion, FAA's severity rating system understates the number of serious operational errors. For example, our analysis of operational errors that occurred from May 1, 2001, when FAA established its severity rating system, through May 31, 2002, showed that the most serious operational errors occurred, on average, once every 3 days, when we included operational errors rated "moderate" that were within 30 seconds of a midair collision.

In the first 5 months of FY 2003, the number of operational errors rated high risk *increased* from 21 to 24, and the number of runway incursions in the 2 high risk categories decreased from 17 to 10 compared to the same period in FY 2002. While the progress in reducing serious runway incursions is encouraging, it is important that FAA take additional actions to further reduce the number and safety risk of operational errors and runway incursions, especially since FAA projects that air traffic operations will return to pre-September 11th growth patterns between 2005 and 2007.

To reduce operational errors further, FAA needs to address the following issues identified during our audit.

➢ FAA considers many operational errors as "moderate" severity when in fact some of these errors are very serious. For example, FAA rated an error as moderate that was less than 12 seconds from a midair collision. FAA needs to modify its rating system to more accurately identify the most serious operational errors, focus its resources on reducing them, and ensure that controllers receive the appropriate training for high risk errors.

➢ FAA procedures do not require training when controllers have multiple operational errors or for controllers who have operational errors that pose a moderate or high safety risk. The procedures state only that skill enhancement training *"may"* be provided and, therefore, are open to interpretation. NTSB has expressed concerns over these procedures. Under these procedures, for example, a controller had three operational errors within a 2-year period, but did not receive any training after the second and third errors because these two errors were categorized as low severity. In addition, our review of 85 moderate and high severity operational errors disclosed that the controllers involved did not receive any formal training for 18 (21 percent) of these errors. FAA needs to revise its procedures to ensure that controllers are trained to reduce the risk of future errors.

➢ The Controller-in-Charge (CIC) Program was expanded as a result of a 1998 agreement between FAA and the National Air Traffic Controllers Association to reduce the number of air traffic control supervisors by about one-third. To offset the reduction of supervisors, FAA agreed to use CICs to provide oversight of air traffic operations during the absence of supervisors. In

January 2001, FAA began its reduction of supervisors and the expanded use of CICs. In the first year (calendar year 2001) of the expanded CIC Program, the number of operational errors that occurred while a CIC was supervising an area increased 46 percent compared to calendar year (CY) 2000. FAA does not know the reason for the increase because it had not performed evaluations of those facilities with increases in operational errors while CICs were on duty. To address concerns identified in our 1998 report[6] on the CIC Program, FAA needs to establish procedures to monitor, at the national level, the impact that the expanded CIC Program has had on operational errors.

➢ FAA needs to provide stronger national oversight of facilities that continue to have high numbers of operational errors. Despite an 11 percent decrease in total operational errors in FY 2002, we found that 13 of the top 27 facilities with the most operational errors made no progress in reducing their errors from FY 2001 levels.

To reduce runway incursions further, FAA needs to implement technologies to prevent runway incursions and hold managers accountable for completing initiatives on schedule as recommended in our June 2001 report. Specifically:

➢ FAA needs to implement technologies to prevent runway incursions. FAA conducted technology reviews of airports that had runway incursion problems, completed its initial review of six low-cost emerging technologies, and initiated actions to expedite surface moving map displays for use by pilots. However, FAA must now ensure these technologies are advanced to high risk airports in a timely manner.

➢ FAA's Runway Safety Program Director still has no authority to ensure initiatives undertaken by various FAA lines of business are completed on schedule. As we have been reporting since 1998, many initiatives to reduce runway incursions have not been completed on schedule. For instance, in August 2000, FAA identified 10 near-term initiatives. However, 7 of these 10 initiatives were completed 6 to 21 months behind schedule. FAA needs to establish a mechanism to hold managers accountable for implementing initiatives to reduce runway incursions on schedule.

## Additional Actions Are Needed to Reduce the Safety Risk Posed by Operational Errors

In December 2000, we reported that FAA needed to approach reducing operational errors with a sense of urgency and provide stronger national oversight to ensure

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[6] "Staffing: Reductions in Supervisors Will Require Enhancements to FAA's Controller-in-Charge Program" (Report Number AV-1999-020, November 16, 1998).

efforts to reduce these errors are effective. FAA initiated actions to improve its oversight efforts and, together with the National Air Traffic Controllers Association (NATCA), established a system to identify the severity, or collision hazard, of operational errors and to focus resources on preventing the most severe errors.

The rating system uses a 100-point scale to rate the severity of errors into three risk categories—low (39 and below), moderate (40 to 89), and high (90 and above). Points are assigned based on vertical and horizontal separation distances, flight paths, closure rate, and level of air traffic control involvement (controlled—controller was aware an error was about to occur, or uncontrolled—controller was not aware an error was about to occur). Those operational errors rated as low are not considered a safety risk and are categorized as technical violations.

The reduction in air traffic operations and FAA initiatives contributed to FAA's progress in reducing operational errors. Most of the decrease in FY 2002 occurred at three facilities. Specifically:

➤ We analyzed the 11 percent decrease in operational errors from FY 2001 to FY 2002 (1,194 to 1,061) and found that the decrease was due in part to the 3 percent reduction in air traffic operations (about 4.2 million operations) during FY 2002. We performed a statistical correlation analysis[7] between air traffic operations and operational errors on a monthly basis for FY 2001 and FY 2002 and concluded there was a positive correlation. In other words, as operations decreased, errors also decreased. We also performed the same statistical correlation analysis for 24 facilities[8] that had decreases in operations in FY 2002 and concluded that there was also a positive correlation on a facility basis.

➤ Sixty-five percent of the total decrease in operational errors nationwide (86 out of a total decrease of 133 errors from FY 2001 to FY 2002) occurred at Washington Center, Los Angeles Center, and New York TRACON. (See Exhibit C for details regarding the decreases at these facilities.) FAA air traffic officials attributed the decrease at these three facilities to an increase in Headquarters and regional oversight. For example, all three facilities had national reviews during FY 2001. Also, the New York TRACON hired a new Quality Assurance manager in April 2001 to focus on identifying causal factors and trends of operational errors, and developing strategies for reducing these

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[7] A statistical correlation analysis measures the extent to which a relationship exists between two or more variables. We used SPSS statistical software and plotted the number of air traffic operations to the number of operational errors to evaluate the correlation, or relationship, that these two variables had with one another.

[8] These 24 facilities were among the top 27 facilities with the most operational errors. The other three facilities had increases in air traffic operations.

errors. It is important to note that these three facilities also experienced a 5 to 7 percent decrease in air traffic operations.

There is no question that FAA has made improvements since we issued our report in December 2000; however, we found that much work remains in reducing operational errors.

➤ For FY 2002, FAA changed its goal from reducing the total number of operational errors to reducing the most serious incidents. However, FAA missed its FY 2002 goal of having no more than 568 operational errors with less than 80 percent of required separation between aircraft,[9] with 617 such errors.

➤ Seventy-eight percent of the 1,103 operational errors that FAA rated during the 13-month period from May 1, 2001, to May 31, 2002, posed a moderate or high safety risk.

➤ FAA's rating system understates the safety risk of the most serious operational errors. Only 61 of 1,103 operational errors were rated "high risk" (90 and above out of 100 points). *However, we found another 65 errors rated in the high end of "moderate" (70 to 89 points) that, in our opinion, were also very serious (within 30 seconds of a midair collision).* On average, operational errors that scored between 70 and 89 points had only 50 percent of the required separation between aircraft. Depending on the closure rate of the aircraft involved, these errors can be only seconds away from an accident. For example, a controller directed two commercial airliners head-on at a closure rate of 460 miles per hour. The two aircraft had only 43 percent of the required 3-mile horizontal separation *and* were less than 12 seconds from a midair collision. The incident was rated as *"moderate,"* scoring 87 points. In our opinion, *this operational error was very serious,* and FAA should consider errors such as this one to be *"high risk."*

➤ FAA does not identify and monitor statistics on the number of operational errors that involve commercial aircraft, general aviation aircraft, and military aircraft. This is important in measuring the overall safety impact of operational errors. For example, operational errors that involve commercial aircraft should be identified and monitored because they can place hundreds of passengers at risk.

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[9] For example, if the required separation between two aircraft was 5 miles horizontally, any operational error that had less than 4 miles (80 percent of 5 miles) between aircraft was considered serious for the purpose of measuring whether FAA met its goal. FAA used the 80 percent separation as a bench mark to identify serious errors because it did not establish a formal severity rating system until April 27, 2001. Therefore, FAA did not have a full year of severity data on which to base its goal.

➤ FAA procedures do not require training when controllers have multiple operational errors or for controllers who have operational errors that posed a moderate or high safety risk. This occurred because, in 2001, FAA and NATCA signed a Memorandum of Understanding establishing new procedures for the types of actions that can be taken when operational errors occur, in part, to change the controllers' belief that actions taken as a result of an operational error were punitive. In the past, supervisors could decertify a controller and provide remedial training even if the error was the controller's first operational error *and* did not pose a safety risk. We agree with FAA's decision to eliminate the perception that actions taken after an operational error are punitive. However, we do not consider training to be punitive. As a result of FAA's new procedures, some controllers with multiple errors or errors that posed a moderate or high safety risk did not receive training. Specifically:

- FAA procedures set no limit on the number of low severity errors a controller could have before training is required; therefore, a controller can have multiple errors and not receive training. The procedures state that *training will not* be provided to controllers who have low severity errors that are controlled (i.e., the controller was aware the error was about to occur). For low severity errors that are uncontrolled, training "may" be provided but is not mandatory. For example, a controller had three operational errors within a 2-year period, but did not receive any training after the second and third errors because these two errors were categorized as low severity. Less than 1 year later, the controller had a fourth operational error that was rated in the high end of moderate. While the controller did receive training after the fourth error, training provided after the second or third error possibly could have prevented the fourth error.

- For controllers who have moderate or high risk errors, FAA procedures state only that training "may" be provided. Our review of 85 moderate and high severity operational errors disclosed that the controllers involved did not receive any formal training for 18 (21 percent) of these errors.

➤ To address concerns identified in our 1998 report on the CIC Program, FAA needs to take additional action to ensure that the Program does not adversely impact safety. The CIC Program was expanded as a result of a 1998 agreement between FAA and NATCA to reduce the number of air traffic control supervisors by about one-third. To offset the reduction of supervisors, FAA agreed to use CICs to provide oversight of air traffic operations during the absence of supervisors.

- In October 2000, we issued a letter to the FAA Administrator urging her to rescind the practice of allowing facilities to designate all controllers as CICs after we were informed that one facility had designated 100 percent of its controllers as CICs. Our review of more recent FAA data[10] found that at least 118 facilities either set a goal of designating or had designated 100 percent of their controllers as CICs. This may be necessary at smaller facilities; however, designating 100 percent of controllers as CICs at larger facilities is not reasonable. While FAA maintains that all CICs are qualified, Congress has been concerned, as we were, that allowing facilities to designate <u>all</u> controllers as CICs did not ensure that only the most qualified controllers are selected. Because of this concern and due to the increasing number of operational errors and runway incursions, Congress, in the FY 2002 Appropriations Bill, halted the further reduction of the number of supervisors and expansion of the CIC Program.

- FAA needs to establish procedures to monitor, at the national level, the impact on operational errors of the expanded CIC Program and reduction in the number of supervisors. Our analysis indicates that the CIC Program, since it was expanded in January 2001, *may be* negatively impacting operational errors. In CY 2001, the number of errors that occurred while a CIC was supervising an area increased 46 percent over CY 2000, even though the number of CIC hours worked increased only 14 percent. FAA did not know the reason for the increase because it had not performed evaluations of those facilities with increases in operational errors while CICs were on duty.

  According to FAA air traffic officials, there could be other factors contributing to the increase in operational errors while CICs are on duty. For example, CICs may be working during the busier periods when an error is more likely to occur. However, in our opinion, the statistics are an *indicator* that the CIC Program *may be* adversely impacting operational errors, and these statistics warrant a more detailed review. Until FAA conducts detailed evaluations of those facilities that have significant increases in operational errors while CICs are on duty, the reasons for the increases will not be known.

➔ FAA did not substantially improve its national oversight of regions and facilities with high numbers of operational errors as recommended in our December 2000 report. For example, three of the four regions we visited provided little documentation to show that they had visited problem facilities,

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[10] FAA facility evaluation data for 156 facilities that had facility evaluations performed between July 24, 2001, and May 23, 2002.

identified problems linked to operational errors, and followed up to ensure identified problems were corrected.  Also, FAA did not complete its review and approval of regional quality assurance plans that were revised based on guidance issued in August 2001.

In addition, in July 2001, FAA established a position for a National Program Manager for Quality Assurance to oversee and improve regional and facility efforts to reduce operational errors, including the review and approval of regional quality assurance plans.  However, the person assigned to this position was detailed to act as an assistant facility manager at a major air traffic control tower for 7 months from April to November 2002.  FAA should ensure that the National Program Manager for Quality Assurance position remains permanently staffed.  In addition, once FAA completes its review of regional quality assurance plans, FAA needs to periodically assess the regions' efforts to correct facility-specific problems.

To its credit, FAA, in conjunction with NATCA, issued a 3-year plan in August 2002 to prevent operational errors.  This plan is a step in the right direction and includes some key actions to reduce operational errors.  For example, the plan contains actions to improve controller training and establishes a National Safety Board that will be responsible for identifying and reviewing at-risk facilities.  Also, in FY 2002, FAA initiated two key human factors studies to improve controller performance and better identify the causal factors of errors.  The key to the success of these initiatives is that FAA follows through and completes the initiatives in a timely manner.

To better focus its resources on those operational errors that truly represent the greatest safety risk, FAA needs to reexamine its decision to assign only an 11-point range (90 to 100) for high severity errors and expand the range below the 90-point lower limit so that all errors that pose a very serious safety risk are treated as high severity errors.  Also, to further reduce operational errors, FAA must ensure that controllers with multiple operational errors or errors that pose a moderate or high safety risk receive training.  In addition, FAA needs to establish quality assurance procedures at the national level to monitor the safety impact of the expanded CIC Program on a facility-by-facility basis and perform detailed evaluations of those facilities that have significant increases in operational errors while CICs are on duty.  If actions taken do not reverse the upward trend in operational errors while CICs are on duty, then FAA should limit the use of CICs to only the most qualified candidates.

## Actions Are Needed to Reduce Runway Incursions Further

FAA continued to focus on reducing runway incursions and has made progress this past year. In June 2001, FAA established a system to categorize runway incursions into four levels of accident risk to target reduction efforts on the most serious incursions. The four risk levels described in part are:

- A: barely avoid a collision,
- B: significant potential for a collision,
- C: ample time and distance exists to avoid a potential collision, and
- D: little or no risk of a collision exists.

In addition, FAA's full-time regional runway safety managers, appointed in October 2000, conducted a total of 183 safety evaluations of runways at specific airports in FYs 2001 and 2002. The safety evaluations are used to identify runway-specific problems that may lead to runway incursions and to identify actions to correct these problems.

For FY 2002, FAA changed its goal from reducing the total number of runway incursions to reducing the most serious incidents. Its goal was to have no more than 53 runway incursions in the two highest risk categories, those incursions that barely avoided or had significant potential for a collision. As shown in Figure 3, FAA has made progress in reducing runway incursions in the two highest risk categories (Categories A and B) overall and in reducing the number of Category A and B incursions that involve commercial aircraft. In FY 2002, FAA met its goal with 37 Category A and B incursions—a decrease of 30 percent from FY 2001. However, in FY 2002, the high risk runway incursions still occurred about once every 10 days.

### *Figure 3—Category A and B Incursions*
### *FYs 1998-2002*
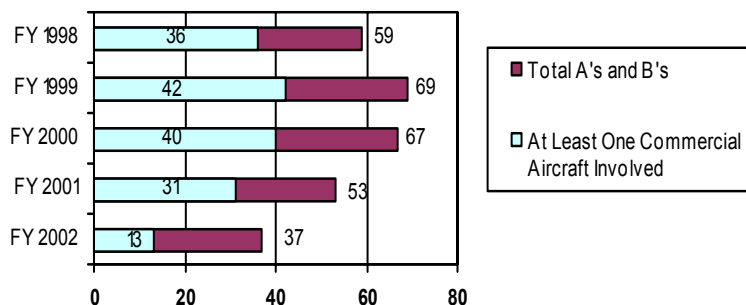
FAA's improved national oversight and focus on more serious runway incursions contributed to FAA's progress in reducing runway incursions in FY 2002. However, we also found that a reduction in air traffic operations as well as site-specific improvements at airports contributed to FAA's progress. Specifically:

⤷ We found the decrease in runway incursions from FY 2001 to FY 2002 was due in part to the 2 percent reduction in air traffic tower operations (about 1.3 million operations) during FY 2002. We performed a statistical correlation analysis on a monthly basis for FY 2001 and FY 2002, comparing total tower operations to runway incursions, and concluded there was a positive correlation. In other words, as tower operations decreased nationwide, runway incursions decreased. Conversely, the more tower operations there are nationwide, the more opportunities exist for a runway incursion or runway accident.

⤷ As stated in FAA's June 2002 Runway Safety Report,[11] traffic volume is not the only factor contributing to the potential for runway incursions. Airport-specific factors also influence the possibility for a runway incursion. For instance, 31 percent of the total decrease in runway incursions nationwide (21 out of a total decrease of 68 incursions from FY 2001 to FY 2002) occurred at 3 airports: John Wayne Airport, Orange County, California; Fort Lauderdale Executive Airport, Florida; and Buchanan Field, Concord, California. Runway safety officials attribute the decrease in runway incursions at these airports to national, regional, and site-specific initiatives to reduce runway incursions. For example, FAA conducted runway safety reviews at these three airports during FY 2001 or FY 2002. As a result, improvements, such as better runway/taxiway markings, signs, and lighting systems, were made at these airports to prevent runway incursions. In addition, pilot education programs were implemented.

In response to recommendations made in our June 2001 report, FAA initiated several actions to identify technologies to reduce runway incursions. FAA completed its initial review of six low-cost emerging technologies in July 2002 and recommended that three of the technologies be further evaluated. These three technologies (ground markers, runway status lights, and smart boards)[12] should improve pilot situational awareness and help prevent pilot deviations, the leading cause of runway incursions. FAA's next step is to ensure that these

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[11] "FAA Runway Safety Report - Runway Incursion Trends at Towered Airports in the United States," CY 1998 – CY 2001, dated June 2002.

[12] Ground markers transmit audible messages to the pilot regarding the runway status, i.e., alert the pilot if the runway is occupied. Runway status lights provide the pilot a visual signal, similar to a traffic light, regarding the runway status. Smart boards are electronic bulletin boards that are placed at taxiway/runway intersections to provide pilots with advisory messages.

technologies are advanced to high risk airports, as recommended.  FAA also conducted reviews at the 13 problem airports identified in our June 2001 report plus 3 additional airports and published its findings and recommendations on January 29, 2003, in its Runway Incursion Airport Assessment Report.  Now, FAA must ensure recommended actions are implemented in a timely manner.

FAA and the aviation industry have not made a decision to expedite technologies, such as the in-cockpit surface moving map displays, that may have significant potential for reducing runway incursions caused by pilots.  According to FAA officials, efforts to expedite these technologies have been slowed due to the economic slowdown of the airline industry, which became more pronounced after September 11th.  FAA officials stated that because major investments in security are being made while revenue is down, most airlines have no budget for new avionics.  In an effort to expedite moving map technology, FAA is working with the aviation industry in developing a portable surface moving map display that can be used with an Electronic Flight Bag.[13]  In addition, FAA is moving forward with developing 76 airport surface moving maps by the end of 2004 so the maps will be available once the airlines are able to install the technology needed in the cockpit.

In our June 2001 report, we also reported that improvements in program oversight were needed because initiatives to reduce runway incursions were not completed on time.  FAA runway safety officials believe FAA's ability to meet future milestones in implementing runway safety initiatives will be improved with the implementation of its FY 2002-2004 Runway Safety Blueprint, issued in July 2002.  In developing the Blueprint, FAA coordinated with and obtained approval of all its lines of business.  The Blueprint identifies FAA's goals and initiatives to reduce runway incursions, assigns a lead organization responsibility for each initiative, and requires lead organizations to prepare an implementation plan for each initiative.

However, we are not convinced that actions taken to date will improve program accountability at the national level.  Contrary to our recommendation, FAA's Runway Safety Program Director still has no authority to ensure initiatives undertaken by various FAA lines of business are completed on schedule.  As previously reported, many initiatives to reduce runway incursions over the years were not completed on schedule.  For instance, in August 2000, FAA identified 10 near-term initiatives that were to be completed by early 2001.  Seven of these 10 initiatives were completed 6 to 21 months behind schedule.

In our opinion, the process established by FAA to have the Office of Runway Safety monitor the progress of other lines of business in meeting their milestones

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[13] Electronic Flight Bags can display a variety of aviation data, including runway maps, which in the past were obtained from paper documents or an airline's flight dispatch function.

will not work if the Runway Safety Office has no authority over the lines of business. As recommended in our June 2001 report, FAA needs to establish a mechanism at a level where appropriate actions and priorities can be directed above the lines of business. Without such a mechanism, there is no assurance that actions in this Blueprint will be completed any more timely than actions contained in FAA's four prior action plans issued over the last 10 years.

## RECOMMENDATIONS

To reverse the upward trend in operational errors, we recommend that FAA:

➢ Reexamine its decision to assign only an 11-point range (90 to 100) for high severity errors and expand the range below the 90-point lower limit so that resources are focused on all errors that pose a very serious safety risk.

➢ Identify and monitor statistics on the number of operational errors by commercial, general aviation, and military aircraft.

➢ Require that controllers who are involved in multiple operational errors receive training regardless of the severity rating of the errors, and mandate that training be provided for controllers who have had moderate and high rated operational errors.

➢ Establish procedures to monitor, at the national level, the impact that the expanded CIC Program and reduction in the number of supervisors has had on operational errors on a facility-by-facility basis. For those facilities where operational errors have increased significantly when CICs were on duty, FAA should perform detailed evaluations to identify the reasons for the increases. If the facility is unable to reverse the upward trend in operational errors while CICs are on duty, FAA should limit the use of CICs to only the most qualified candidates.

➢ Improve national and regional oversight by (1) ensuring a permanent National Program Manager for Quality Assurance is assigned to provide oversight of regional efforts to reduce operational errors; (2) completing the review and approval of regional operational error reduction programs; and (3) conducting reviews of regional quality assurance offices to ensure regions are complying with their plans and are held accountable for addressing facilities in their region that do not show progress in reducing operational errors.

FAA must move expeditiously to complete recommendations made in our June 2001 report to reduce runway incursions further. Specifically, FAA needs to (1) advance low-cost technologies to high risk airports; (2) expedite technologies,

such as in-cockpit surface moving map displays, to aid pilots in reducing runway incursions; and (3) improve program accountability. See Exhibit F for details. In addition to completing recommendations in our June 2001 report, FAA also needs to implement recommendations in its Runway Incursion Airport Assessment Report, published January 29, 2003. These recommendations were made as a result of technological reviews of problem airports.

## MANAGEMENT COMMENTS AND OFFICE OF INSPECTOR GENERAL RESPONSE

On March 21, 2003, FAA provided written comments (attached as an Appendix to this report) to our February 26, 2003 draft report. FAA agreed with our recommendation to improve its national oversight of the regions and facilities that do not show progress at reducing operational errors, and indicated that these actions will be completed by May 1, 2003. We consider FAA's proposed actions to be responsive and consider that recommendation resolved. FAA also agreed with our recommendation to implement its human factors initiative for memory enhancement training for controllers, but FAA needs to provide a target date for implementation. We consider FAA's proposed actions to be responsive and consider that recommendation resolved.

On March 28, 2003, FAA provided revised comments to address our two recommendations on revising training requirements for operational errors. FAA officials stated that they are currently involved in a review of existing MOUs, which includes re-examining the provisions of the MOU on training requirements for operational errors. We consider FAA's proposed actions to be responsive, but FAA needs to provide a target date for implementing these recommendations. These recommendations will remain open, and we will monitor FAA's progress in re-examining the MOU and revising training requirements.

However, FAA's proposed actions regarding our recommendations on expanding its severity rating system for serious operational errors, and monitoring the impact of the expanded CIC Program on operational errors, do not fully address the intent of our recommendations and are not responsive. We are requesting that FAA reconsider its position.

➢ Regarding our recommendation to expand the severity rating of operational errors, FAA stated that it would validate the point values for high severity operational errors; however, FAA did not indicate whether it planned to take action to expand the point range for high severity errors. This is important because we found operational errors rated as moderate that posed a serious safety risk. For example, we identified 65 operational errors rated as moderate where the aircraft involved were within 300 feet vertically, had converging

paths, and were within 30 seconds of a midair collision. One of these operational errors involved two commercial airliners, approaching head-on at a closure rate of 460 miles per hour; they were less than 12 seconds from a midair collision when they took evasive action. FAA needs to accurately identify all serious operational errors to ensure that it focuses resources on reducing the most dangerous operational errors.

➢ FAA's response to our recommendation regarding the expanded CIC Program does not indicate what actions FAA plans to take to monitor, at the national level, the impact on operational errors of the CIC Program and the reduction of the number of supervisors. FAA stated it agreed with our recommendation and will include CIC information in the agency's operational error causative analysis efforts. However, it is not clear if FAA's causative analysis efforts will include monitoring the impact of the expanded CIC Program on operational errors. FAA needs to clarify its response and provide us with more details on how it plans to monitor the CIC Program on a facility-by-facility basis. Also, FAA needs to provide us details regarding its plans to conduct evaluations of those facilities that have significant increases in operational errors while CICs are on duty.

For runway incursions, FAA agreed to implement recommendations in its Runway Incursion Airport Assessment Report made as a result of technological reviews of 16 problem airports. FAA indicated that it is working at the field level to coordinate improvements to signs, surface markings, and security. Of the 16 airports, FAA has identified 6 airports for improved airport marking and signs, and it indicated that work at 4 of these airports has been completed. FAA is also working at other airports to test improvements to surface operations. FAA plans to complete this work in 2004 and begin to work at higher capacity commercial and general aviation airports in 2005. When fully implemented, these actions should help further reduce runway incursions. Accordingly, we consider FAA's proposed actions to be responsive, and we consider these recommendations resolved.

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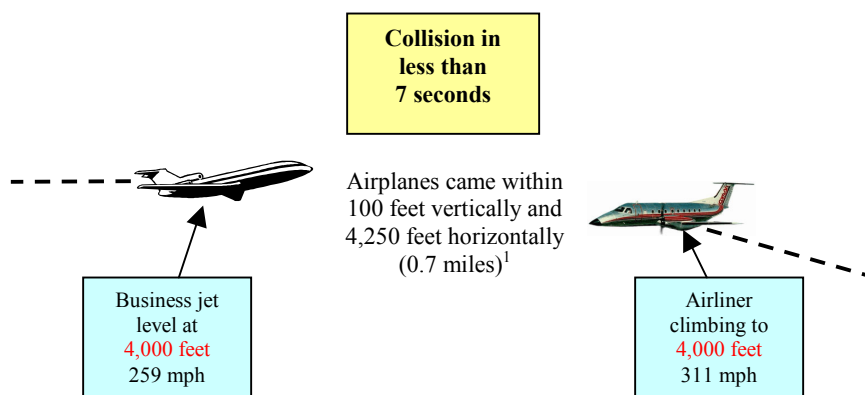
# INTRODUCTION

## *Background*

Operational errors and runway incursions pose very serious safety risks and are critical safety indicators for the Nation's air traffic control system.

An *operational error*[1] occurs when an air traffic controller does not ensure that Federal Aviation Administration (FAA) separation standards are maintained between airplanes. FAA criteria for reporting, investigating and preventing operational errors are contained in FAA's Air Traffic Quality Assurance Order, 7210.56C, dated August 15, 2002.

Operational errors occur mostly in the air[2] and can pose a very serious safety risk. For example, in April 2002, an operational error occurred at the Atlanta Terminal Radar Approach Control (TRACON) when a controller directed a commercial airliner and a business jet onto converging courses. As depicted in Figure 1, the aircraft were about 7 seconds from a midair collision when the pilots took evasive action, averting an accident.

## *Figure 1—Operational Error at the Atlanta TRACON*



**Collision in less than 7 seconds**

Airplanes came within 100 feet vertically and 4,250 feet horizontally (0.7 miles)[1]

Business jet level at 4,000 feet 259 mph

Airliner climbing to 4,000 feet 311 mph

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[1] Standard separation in the en route environment is 5 nautical miles horizontally and 1,000 feet vertically up to 29,000 feet, and 2,000 feet vertically above 29,000 feet. Horizontal separation in the terminal environment is generally between 3 and 5 nautical miles depending on the type of airplane. All references to miles in this report are nautical miles. A nautical mile is equivalent to 6,076 feet.

[2] Historically, about 90 percent of the reported operational errors occur in the air. Operational errors that occur on the runway and create a collision hazard are considered runway incursions.

In July 2002, a midair collision between a Russian passenger airliner and a Boeing 757 cargo plane occurred over southern Germany at an altitude of about 35,000 feet. A total of 71 people were killed. This tragic accident shows just how serious midair collisions can be. The cause of this accident is currently under investigation by the German Federal Bureau of Aircraft Accident Investigations.

*Runway incursions*[3] are incidents on the runway that also create a collision hazard. FAA's Office of Runway Safety has overall responsibility for FAA's Runway Safety Program to prevent and reduce runway incursions. Responsibilities for this office and other FAA organizations with a role in runway safety are contained in FAA's Runway Safety Program Order, 7050.1, dated November 1, 2002.

Several major accidents have occurred on the runway. In October 2000, an accident occurred at Taipei's Chang Kai Shek International Airport when a Boeing 747 took off on a closed runway and collided with construction equipment killing 83 people onboard. More recently, in October 2001, a McDonnell Douglas MD-80 taking off in poor visibility from Linate Airport in Milan, Italy, struck a Cessna business jet that entered the runway by mistake. A total of 118 people were killed in that accident.

Although these accidents did not occur in the United States, they show the extent of the safety risk posed by runway incursions. A similar incident to the one in Milan occurred at the Los Angeles Airport in California in March 2002. A Boeing 737 aircraft entered an active runway without authorization as a Boeing 757 was taking off. The two aircraft were separated by only 200 feet vertically. Since 1990, there have been 9 runway accidents[4] in the United States that claimed 49 lives and damaged 16 aircraft. The National Transportation Safety Board (NTSB) has included reducing runway incursions on its annual "Most Wanted" list of transportation safety improvements since 1990.

## *Objective, Scope, and Methodology*

The objective of this audit was to determine whether FAA is making progress in reducing operational errors and runway incursions. Additionally, we determined whether FAA implemented recommendations contained in our previous reports on

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[3] FAA defines a runway incursion as any occurrence at an airport involving an aircraft, vehicle, person, or object on the ground, that creates a collision hazard or results in a loss of separation with an aircraft taking off, intending to take off, landing, or intending to land. FAA's definition applies only to airports with operating air traffic control towers.

[4] These numbers do not include the runway accident that occurred at Quincy, Illinois, in November 1996 that resulted in 14 fatalities. This accident does not meet FAA's definition of a runway incursion since it occurred at a non-towered airport.

operational errors and runway incursions.[5]  Our field work primarily focused on operational errors because these incidents continued to rise in fiscal year (FY) 2001.  We analyzed operational error and runway incursion data from FY 1998 through February 28, 2003, to evaluate FAA's progress at reducing these incidents.  We also evaluated FAA's process for assigning severity ratings to operational errors.  To determine the status of FAA actions to implement our prior recommendations and to evaluate current initiatives to reduce operational errors, we interviewed air traffic managers and controllers at FAA Headquarters in Washington, D.C.; four FAA regional offices; and nine air traffic control facilities.  To determine the status of FAA actions to implement our prior recommendations on runway incursions, we interviewed representatives from FAA Headquarters and three regional offices.  (See Exhibit A for a list of organizations visited or contacted.)  We conducted the audit between December 2001 and March 2003 in accordance with Government Auditing Standards prescribed by the Comptroller General of the United States.

# FINDINGS AND RECOMMENDATIONS

## *Finding A. Additional Actions Are Needed to Reduce the Safety Risk Posed by Operational Errors*

In December 2000, we reported that FAA needed to approach reducing operational errors with a sense of urgency and provide stronger national oversight to ensure efforts to reduce these errors are effective.  In response to recommendations in that report, in FY 2001 FAA conducted national reviews of 23 problem facilities, established a full-time position to oversee regional efforts to reduce operational errors, and issued guidance to improve regional operational error reduction plans.  Also, on April 27, 2001, FAA established a system to rate the severity of operational errors.

However, operational errors reached a 10-year record high of 1,194 incidents in FY 2001, even though the number of air traffic operations decreased 3.1 percent from the previous year.  In FY 2002, there were 1,061 operational errors, a decrease of 133 errors, or 11 percent, from FY 2001.  However, the number of

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[5] "Actions to Reduce Operational Errors and Deviations Have Not Been Effective" (Report Number AV-2001-011, December 15, 2000), and "Despite Significant Management Focus, Further Actions Are Needed to Reduce Runway Incursions" (Report Number AV-2001-066, June 26, 2001).  See Exhibits E and F, respectively, for the status of recommendations from these reports.

operational errors is still 20 percent higher than the number of operational errors that occurred in FY 1998, when air traffic operations were about the same as FY 2002 levels.[6]

For FY 2002, FAA's goal was to have no more than 568 operational errors that had less than 80 percent of the required separation between aircraft. FAA used the 80 percent separation to identify serious errors because it did not have a full year of severity data on which to base its goal. However, FAA missed its FY 2002 goal of 568 by about 9 percent, with 617 operational errors that had less than 80 percent separation.

In FY 2002, FAA records showed that the most serious operational errors (those rated as high risk) occurred, on average, once every 8 days. In our opinion, FAA understates the number of the most serious operational errors by only considering the high risk errors. For example, our analysis of operational errors that occurred from May 1, 2001, when FAA established its severity rating system, through May 31, 2002, showed that the most serious operational errors occurred, on average, once every 3 days, when we included operational errors rated "moderate" that were within 30 seconds of a midair collision.

In the first 5 months of FY 2003, operational errors have decreased 4 percent, from 414 to 398 compared to the same period in FY 2002. However, during this same 5-month period, operational errors rated as *high* risk have *increased* from 21 to 24 compared to the same period in FY 2002. Therefore, it is important that FAA take additional actions to further reduce the number and safety risk of operational errors, especially since FAA projects that air traffic operations will return to pre-September 11th growth patterns between 2005 and 2007.

We analyzed the decrease in operational errors from FY 2001 to FY 2002 (1,194 to 1,061) to determine the impact the reduction in air traffic operations may have had on the decrease in errors. While operational errors decreased 11 percent (133 errors) from FY 2001 to FY 2002, air traffic operations decreased almost 3 percent, or about 4.2 million operations.[7] We performed a statistical correlation analysis[8] between air traffic operations and operational errors on a monthly basis for FY 2001 and FY 2002 and concluded there was a positive correlation. In other words, as operations decreased, errors also decreased. We also performed the

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[6] Air traffic operations data from FAA's Air Traffic Operations Network (OPSNET) database show that FY 2002 operations were about .2 percent less than FY 1998 operations.

[7] The total number of air traffic operations for FY 2002 was obtained from FAA's OPSNET database and includes the operations from all air traffic facilities: towers, TRACONs, and en route centers.

[8] A statistical correlation analysis measures the extent to which a relationship exists between two or more variables. We used SPSS statistical software and plotted the number of air traffic operations to the number of operational errors to evaluate the correlation, or relationship, that these two variables had with one another.

same statistical correlation analysis for 24 facilities[9] that had decreases in operations in FY 2002 and concluded that there was also a positive correlation on a facility basis.  (See Exhibit B for additional data regarding this analysis.)

However, traffic volume is not the only reason operational errors decreased. Specifically, 65 percent of the total decrease in operational errors nationwide (86 out of a total decrease of 133 errors from FY 2001 to FY 2002) occurred at Washington Center, Los Angeles Center, and New York TRACON.  FAA air traffic officials also attributed the decrease at these three facilities to an increase in Headquarters and regional oversight.  For example, all three facilities had national reviews during FY 2001.   Also, the Los Angeles Center implemented several initiatives to reduce operational errors, including improvements in supervisory oversight and establishment of incentive awards for reducing operational errors. The New York TRACON hired a new Quality Assurance manager in April 2001 to focus on identifying causal factors and trends of operational errors, and developing strategies for reducing these errors.

## Operational Errors Pose a Serious Safety Risk

On April 27, 2001, FAA and the National Air Traffic Controllers Association (NATCA) implemented a system to identify the severity, or collision hazard, of operational errors and to focus resources on preventing the most severe errors. The system uses a 100-point scale to rate the severity of errors into 3 severity levels, as shown in Figure 2.

## *Figure 2—FAA's Operational Error Severity Rating System*

| Severity Level | Point Range |
| --- | --- |
| High | 90 and above |
| Moderate | 40 to 89 |
| Low | 39 and below |

Points are assigned based on vertical and horizontal separation distances between aircraft (i.e., how close the aircraft came to one another), flight paths (i.e., converging versus same direction), closure rate (the combined speeds of converging aircraft), and level of air traffic control (for example, 20 points are assigned to operational errors that are considered *uncontrolled,* that is, the controller was unaware a loss of separation was about to occur).

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[9] These 24 facilities were among the top 27 facilities with the most operational errors.  The other three facilities had increases in air traffic operations.

We reviewed severity rating data for a 13-month period from May 1, 2001, to May 31, 2002, and found that 857, or 78 percent, of the 1,103 operational errors rated posed a moderate to high safety risk, as shown in Figure 3. Based on our statistician's analyses, a more desirable statistical distribution, depicted by the curved line in Figure 3, would be to have more low rated errors and very few moderate to high rated errors. Our statistician concluded that the distribution of operational errors should not represent a Bell or Normal curve, given the undesirable nature of operational errors. Instead, the desired distribution should be positively skewed, meaning that there should be a high number of "minor" errors and a very small number of "severe" errors, relative to the total errors reported. However, this is **not** the current state of operational errors. In fact, the distribution of operational error severity ratings is almost negatively skewed, which clearly shows that much work remains in reducing the overall safety risk of operational errors.

### Figure 3—Actual Versus Desired Operational Errors Severity Distribution—May 1, 2001 to May 31, 2002
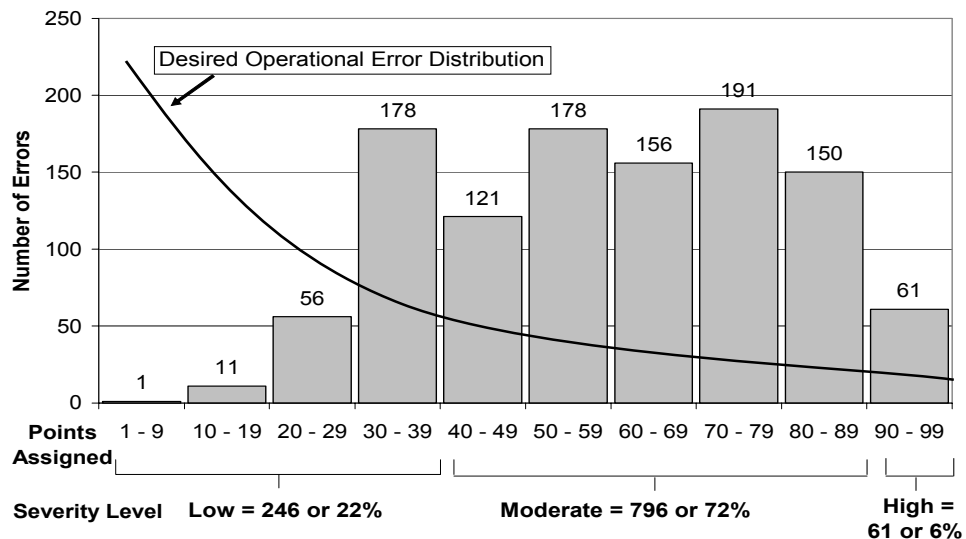


Because 78 percent of the operational errors rated posed a moderate to high safety risk, it is important that FAA reduce the overall risk starting with the most serious errors. As shown in Figure 3, of the 1,103 operational errors rated during the 13-month period from May 1, 2001, to May 31, 2002, FAA rated 61 as high severity (90 to 99 points). As described in the following examples, high severity errors are incidents where the aircraft barely avoided a collision.

➢ In May 2002, an operational error occurred at the Rochester, New York TRACON when a controller allowed two commercial airliners to lose

separation as they approached head-on.  The airliners came within 200 feet vertically and 0.13 miles (about 790 feet) horizontally of a midair collision, as the pilot of one of the aircraft, responding to a Traffic Alert and Collision Avoidance System (TCAS) alert, took evasive action averting an accident. This incident scored 96 points.

➢ In October 2002, an operational error occurred at the Atlanta, Georgia TRACON when a controller allowed a large commercial airliner to pass a smaller commercial airliner within 1,000 feet horizontally at the same altitude. Wake turbulence separation requires aircraft to be no closer than 4 miles, or over 24,000 feet, behind certain larger aircraft.  Maintaining wake turbulence separation is important because wake vortices (the disruption in the air generated by the wing tips of an aircraft, similar to the wake of a boat) can cause a trailing aircraft to move unexpectedly, lose control, and possibly crash. This incident scored 94 points.
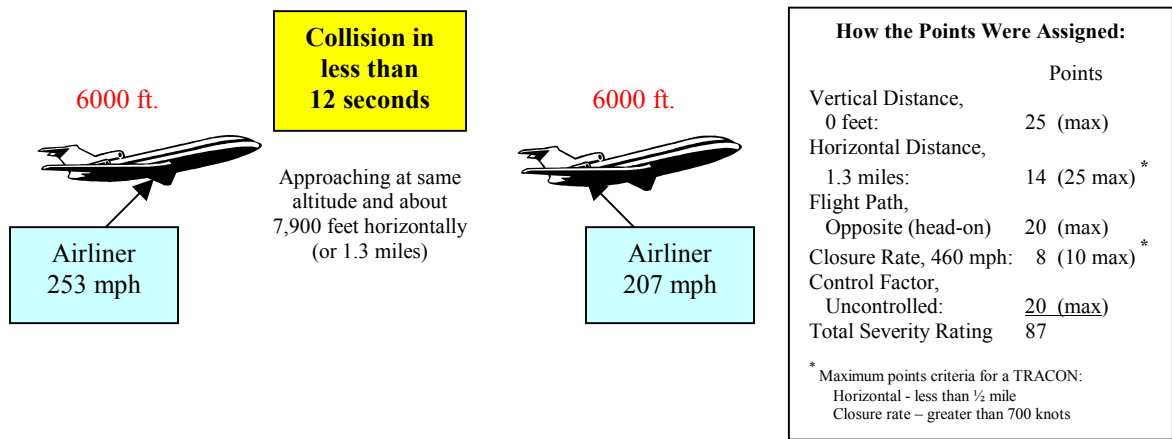
Operational errors like these, where an accident is barely avoided, illustrate the need for FAA to focus resources on reducing operational errors with a sense of urgency.

## FAA's Severity Rating System Needs to Be Refined So That It Better Identifies the Most Serious Operational Errors

Although FAA established a system to rate the severity of operational errors so it can focus its resources on the most severe errors, the rating system does not provide the true extent of the safety risk of an operational error.  We found errors classified as moderate that, in our opinion, posed a very serious safety risk. Specifically, of the 1,103 operational errors FAA rated during the 13-month period from May 1, 2001, to May 31, 2002, 61 errors, or 6 percent, were rated as high. However, the rating categories, by design, allow for comparatively few errors to be rated high (90 to 100) since the point range is only 11 points whereas moderate errors are assigned a range of 50 points (40 to 89).

We found operational errors rated at the high end of "moderate" that, in our opinion, were also very serious and should be rated "high" severity.  For example, as depicted in Figure 4, a very serious error occurred at the Philadelphia TRACON in June 2001, when a controller directed one airliner head-on with another airliner at a closure rate of 460 miles per hour.  The two aircraft had only 43 percent of the required 3-mile horizontal separation *and* were less than 12 seconds from a midair collision.  However, FAA rated this operational error as *"moderate"* with a score of 87 points.  It should also be noted that this error scored the maximum number of points in 3 of the 5 rating categories (vertical distance, flight path, and control factor).

## Figure 4—Example of a Serious Operational Error Rated as Moderate



**Collision in less than 12 seconds**

6000 ft.        6000 ft.

Approaching at same altitude and about 7,900 feet horizontally (or 1.3 miles)

Airliner 253 mph        Airliner 207 mph

**How the Points Were Assigned:**

|  | Points |
|---|---|
| Vertical Distance, 0 feet: | 25 (max) |
| Horizontal Distance, 1.3 miles: | 14 (25 max)[*] |
| Flight Path, Opposite (head-on) | 20 (max) |
| Closure Rate, 460 mph: | 8 (10 max)[*] |
| Control Factor, Uncontrolled: | 20 (max) |
| Total Severity Rating | 87 |

[*] Maximum points criteria for a TRACON:
Horizontal - less than ½ mile
Closure rate – greater than 700 knots

In our view, categorizing errors such as this one as "moderate" is misleading. We found that 95 percent of operational errors that scored between 70 and 89 points *were considered "uncontrolled," which means the controller was not aware the error was about to occur.* Also, on average, these errors had only 50 percent of the required separation. Depending on the closure rate of the aircraft involved, these errors can be only seconds away from an accident.

For example, using FAA's severity rating data, we calculated the maximum closure rate for errors with less than 300 feet vertical separation and converging flight paths to identify those incidents that were within 30 seconds of a midair collision. We found that 65 of the 98 operational errors[10] that were 30 seconds or less from a midair collision were scored between 70 and 89 points. By adding these 65 errors that were rated in the high end of "moderate" (70 to 89) to the 61 errors FAA rated as "high," we concluded that as many as 126 operational errors, or 11 percent of the 1,103 errors rated between May 1, 2001, and May 31, 2002, could be considered very serious. In other words, the most serious operational errors occurred about once every 3 days during this 13-month period.

In April 2002, FAA divided its moderate-rated operational errors into two categories: uncontrolled and controlled. Uncontrolled moderate errors are considered more serious because the controller was unaware that a loss of separation was about to occur and did not take timely action to prevent the error. FAA established its FY 2003 goal based on reducing the total number of moderate-uncontrolled and high severity errors.

However, FAA actions do not address our concerns that the severity rating system does not clearly identify the most serious errors as high risk. Consequently, FAA

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[10] For the remaining 33 errors, 31 were scored between 90 and 100 points and 2 were scored between 50 and 69 points.

may not be able to accurately identify at-risk facilities—those facilities that have high severity errors—and ensure controllers receive appropriate training for high risk errors. Therefore, FAA needs to refine its point range used to identify high severity operational errors so that **all** operational errors that pose a serious safety risk are considered as high severity. Using its current severity system, the number of close calls is understated.

In addition, FAA needs to identify and monitor statistics on the number of operational errors by commercial, general aviation, and military aircraft. This is important in measuring the overall safety impact of operational errors. For example, operational errors that involve commercial aircraft should be identified and monitored because they can place hundreds of passengers at risk.

## FAA Procedures Do Not Require Training When Controllers Have Multiple Operational Errors or Errors That Pose a Moderate or High Safety Risk

On January 17, 2001, FAA and NATCA signed a Memorandum of Understanding (MOU) establishing new procedures for the type of actions that can be taken when operational errors occur. On April 27, 2001, in conjunction with implementing the new severity rating system, FAA and NATCA expanded the MOU to take into account the severity rating of the incident. On August 15, 2002, the MOU procedures were incorporated into FAA's Air Traffic Quality Assurance Order 7210.56C. One reason for the change in these procedures was that controllers believed that actions taken as a result of an operational error were punitive. In the past, supervisors could decertify a controller and provide remedial training even if the error was the controller's first operational error *and* did not pose a safety risk. We agree with FAA's decision to eliminate the perception that actions taken after an operational error are punitive; but we do not consider training to be punitive.

However, FAA's procedures under the MOU and quality assurance order do not require training when controllers have multiple operational errors or for controllers who have operational errors that pose a moderate or high safety risk. In addition, the procedures do not allow managers to revoke or suspend Control Tower Operator licenses and Facility Ratings of controllers who have performance deficiencies.

*Controllers With Multiple Errors*

Training is not required for a controller who has a low severity error classified as a technical violation,[11] even if the controller has had previous errors. In fact, there is no limit on the number of technical violations a controller can have before training is required. In our view, when a controller has more than one operational error, this represents a potential performance problem that should be addressed through the appropriate training before a more serious operational error occurs. For example, a controller had three operational errors within a 2-year period, but did not receive any training after the second and third errors because the errors were categorized as technical violations. Less than 1 year later, the controller had a fourth operational error that was rated in the high end of moderate. While the controller did receive training after the fourth error, training provided after the second or third error possibly could have prevented the fourth error.

Further, our review of FAA operational error data showed that the number of controllers with more than 1 error in the past 2½ years[12] has increased 32 percent, from 145 in FY 1999 to 191 in FY 2001. In FY 2001, 39 of the 191 controllers who had more than 1 error, made operational errors that were categorized as technical violations. FAA procedures do not require the controllers to receive any training for technical violations.

NTSB expressed concern that there was no limit on the number of technical violations a controller could have. In a letter to FAA, dated February 7, 2001, and in congressional testimony[13] on March 28, 2001, NTSB indicated that it would expect that an "acceptable number of these violations would be strictly limited, and that such errors would not become routine." NTSB also stated "Standards that can be violated repeatedly without consequence are no longer standards."

*Controllers With Moderate or High Errors*

FAA does not require that training be provided for controllers who have moderate or high severity operational errors. Our review of 85 moderate and high severity operational errors disclosed that the controllers involved did not receive any formal training for 18 (21 percent) of these errors. For example, a controller's

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[11] With the implementation of FAA's severity rating system in April 2001, all low severity operational errors are classified as technical violations. Training is prohibited for errors that have an air traffic control classification of "controlled." For low severity errors classified as "uncontrolled," training "*may be*" required, but it is not mandatory. Prior to implementing the severity system, the January 17, 2001 MOU required all errors with 80 percent or more of required separation between aircraft to be classified as technical violations. Training was prohibited for all of these errors.

[12] In accordance with union provisions, FAA maintains records of operational errors for individual employees for a 2½-year period. After the 2½-year period, all record of the operational error is removed from the employee's files.

[13] Testimony of Carol Carmody, Acting Chairman, NTSB, before the Committee on Appropriations, Subcommittee of Transportation and Related Agencies, House of Representatives, Regarding Aviation Safety, March 28, 2001.

failure to properly sequence air traffic on arrival into an airport resulted in four operational errors within a 6-minute period. Two errors were rated as high and two were rated as moderate. The supervisor reviewed the voice and radar tapes with the controller and made suggestions to improve performance, but the controller received no formal training. FAA procedures for determining what actions to take after moderate or high severity errors are not clear. The procedures state only that skill enhancement training *"may"* be provided and, therefore, are open to interpretation. Instead, the procedures should set a minimal level of training.

## FAA's Actions to Address Controller Performance Deficiencies Are Limited

The MOU dealing with operational errors and FAA's Air Traffic Quality Assurance Order 7210.56C do not allow managers to revoke or suspend Control Tower Operator licenses and Facility Ratings of controllers who have performance deficiencies. NTSB, in its February 2001 letter to FAA, stated that this provision appears to preclude the FAA from revoking or suspending controller certificates and facility ratings as a means of addressing performance deficiencies. NTSB indicated "It is difficult to discern the safety benefit in the FAA prospectively waiving the right to suspend or revoke facility ratings or initiate a certificate action against a controller who demonstrates serious performance deficiencies." NTSB went on to state "If an individual's performance is of such concern that these actions appear necessary, we expect that FAA would proceed accordingly." We found that FAA officials at one region and facility[14] had concerns regarding performance deficiencies of controllers and indicated that the MOU and FAA procedures limited the actions they could take to address controller deficiencies.

While we recognize that only a small number of controllers make operational errors, FAA needs to strengthen its actions to address controller performance deficiencies when operational errors are made. In FY 2001, less than 2 percent of the controller workforce (only 191 controllers in a workforce of about 15,000) had more than 1 operational error. FAA needs to ensure that training is provided to controllers who continue to make operational errors, regardless of the severity, to address the factors causing the errors. A minimum level of training should be required for controllers who make a moderate or high risk operational error. To address serious performance deficiencies for continued operational errors, even after training is provided, FAA should take steps, in conjunction with NATCA, to rescind the applicable provisions in the MOU and the air traffic quality assurance order that preclude managers from revoking or suspending a controller's Control Tower Operator license or Facility Rating based on performance deficiencies.

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[14] This region and facility were not among the locations we visited during our review.

## FAA Needs to Determine if the Expanded Use of the CIC Program Has Increased Operational Errors

To address safety concerns identified in our 1998 report on the Controller-in-Charge (CIC) Program,[15] FAA needs to take additional action to ensure that the Program does not adversely impact safety. The CIC Program was expanded as a result of a 1998 agreement between FAA and NATCA to reduce the number of air traffic control supervisors by about one-third. To offset the reduction of supervisors, FAA agreed to use CICs to provide oversight of air traffic operations during the absence of supervisors. In January 2001, FAA began its reduction of supervisors and the expanded use of CICs.

In October 2000, we issued a letter to FAA urging it to rescind its practice of allowing all controllers to become CICs after we were informed that one facility had designated 100 percent of its controllers as CICs. Based on our review of more current FAA data,[16] at least 118 facilities either set a goal of designating or had designated 100 percent of their controllers as CICs. This includes large facilities such as the Dallas-Fort Worth Tower, the Atlanta Tower/TRACON and En Route Center, and LaGuardia Tower. While designating 100 percent of controllers as CICs may be necessary at smaller facilities, it is not reasonable for larger facilities. While FAA maintains that all CICs are qualified, Congress was concerned, as we were, that FAA was allowing facilities to designate <u>all</u> controllers as CICs, rather than ensuring that only the most qualified controllers are selected. Because of this concern and the increasing number of operational errors and runway incursions, Congress, in the FY 2002 Appropriations Bill, halted further expansion of the CIC Program and reduction of the number of supervisors. Further, our analysis indicates that the CIC Program *may have had* a negative impact on operational errors and that additional actions are needed to monitor the safety of this Program.

To evaluate the impact of this Program, we compared the number of operational errors that occurred while CICs were supervising with the number of errors that occurred while supervisors were supervising for calendar years (CY) 2000 and 2001.[17] We found that operational errors that occurred when a CIC was responsible for supervising the area *increased at a much greater rate than did the use of CICs*. As shown in Figure 5, the percentage increase in operational errors

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[15] "Staffing: Reductions in Supervisors Will Require Enhancements to FAA's Controller-in-Charge Program" (Report Number AV-1999-020, November 16, 1998).

[16] FAA facility evaluation data for 156 facilities that had facility evaluations performed between July 24, 2001, and May 23, 2002.

[17] Overall, operational errors increased from 1,137 to 1,183, or 4 percent. FAA's database did not indicate for 8 of the 1,137 operational errors in CY 2000 and 61 of the 1,183 operational errors in CY 2001 whether a supervisor or CIC was on duty.

was three times the percentage increase in hours CICs were used.  Further, these errors, as a percentage of total errors, also increased.

### Figure 5—Number of CIC Hours Worked Compared to Number of Errors While a CIC Was on Duty

|  | CY 2000 | CY 2001 | Change | Percent Increase |
|---|---|---|---|---|
| Number of CIC Hours* | 2,044,222 | 2,321,485 | 277,263 | **13.6%** |
| Number of Errors When CIC on Duty | 138 | 201 | 63 | **45.7%** |
| Percentage of Total Errors | 12% | 17% | 5% | -- |

* We obtained the number of CIC hours from the Civilian Unified Payroll System (CUPS).  About 9,000 controllers have been certified as CICs, but they are not used on a full-time/daily basis.  Therefore, it was more accurate to use the number of hours CICs worked instead of the number of CIC positions for these calculations.

The following are examples of facilities where operational errors increased while a CIC was responsible for supervising the area.

➢ At the Chicago en route center, operational errors that occurred while CICs were on duty increased 400 percent, from 2 in CY 2000 to 10 in CY 2001.  However, the hours that CICs were used increased only 209 percent.

➢ At the Baltimore-Washington air traffic control facility, operational errors that occurred while CICs were on duty increased from one in CY 2000 to three in CY 2001, or 200 percent.  However, the number of hours CICs were used increased only 19 percent.  Further, all three operational errors that occurred in the first 5 months of CY 2002, happened while CICs were on duty.

We recognize that an increase in the number of operational errors while CICs are on duty does not alone prove that the Program has had an adverse impact on safety.  According to FAA air traffic officials, there could be other factors contributing to the increase in operational errors while CICs are on duty.  For example, CICs may be working during the busier periods when an error is more likely to occur.  However, in our opinion, the statistics are an *indicator* that the CIC Program *may be* adversely impacting operational errors, and these statistics warrant a more detailed review.  Until FAA performs detailed evaluations of those facilities that have significant increases in operational errors while CICs are on duty, the reasons for the increases will not be known.

Accordingly, FAA needs to establish quality assurance procedures at the national level to monitor the safety impact of the CIC Program on a facility-by-facility

basis and perform detailed evaluations of those facilities that have significant increases in operational errors while CICs are on duty. In doing so, FAA needs to closely evaluate the qualifications of controllers performing CIC functions and the quality of training. If actions taken do not reverse the upward trend in operational errors while CICs are on duty, then FAA should limit the use of CICs to only the most qualified candidates.

## FAA Needs to Take More Aggressive Actions to Correct Regional and Facility-Specific Problems

We found that FAA needs to take more aggressive actions to meet the intent of recommendations in our December 2000 report to improve its national oversight of regions and facilities with high numbers of operational errors.

### *Oversight of Regions*

FAA needs to take more aggressive actions to improve its national oversight of regional efforts to reduce operational errors.

➢ Three of the four regions that we visited (Great Lakes, Southern, and Eastern) provided little documentation to show that they had visited problem facilities, identified why operational errors were occurring, and followed up to ensure identified problems were corrected. In FY 2002, the Great Lakes Region led the Nation with the most operational errors and experienced a 19 percent increase over FY 2001. Also, the Great Lakes and Southern Regions did not meet their regional goals for errors with less than 80 percent separation between aircraft.

On the other hand, the fourth region we reviewed, Western-Pacific Region, had a structured process and plan in place to identify, track, and review facilities with operational error problems. Not surprisingly, the Western-Pacific Region was one of only two of FAA's regions that met FAA's FY 2001 goal of no more than five errors per million operations. In addition, in FY 2002, this region's operational errors decreased 22 percent, and the region met its regional goal of no more than 65 operational errors with less than 80 percent separation between aircraft.

➢ FAA had not completed its review and approval of regional quality assurance plans that were revised based on guidance issued in August 2001. Regional quality assurance plans are important because they include the initiatives the region plans to take to prevent and reduce operational errors and should be used to measure the effectiveness of regional actions to reduce operational errors.

➢ In response to our report, in July 2001, FAA established a full-time position for a National Program Manager for Quality Assurance to oversee and improve regional and facility efforts to reduce operational errors. One of the key duties for this person was to review the regional plans to ensure they met the intent of national guidelines. However, the person assigned to this position had been detailed to several special projects and, in April 2002, was detailed to act as an assistant facility manager at a major air traffic control tower for 7 months. FAA transferred this person back to this position in November 2002.

Once FAA completes its review of regional quality assurance plans, FAA needs to hold the regions accountable for implementing regional initiatives to reduce operational errors. To do so, FAA should periodically assess the regions' efforts to ensure progress is being made in correcting facility-specific problems.


## *Oversight of Facilities*

FAA has taken action to improve its national oversight of problem facilities since we issued our report in December 2000, but more aggressive actions are still needed. For example, 13 of the top 27 facilities with the most operational errors in FY 2002 made no progress in reducing their errors from FY 2001 levels (see Exhibit C). We found that although FAA had performed national reviews of problem facilities, improvements were needed to ensure (a) recommended actions were completed timely and were effective at reducing errors, and (b) reviews of problem facilities were consistent in identifying and tracking problems related to operational errors. Specifically:

✈ In FY 2001, FAA completed national reviews of 23 facilities with the most operational errors or increasing trends in operational errors. However, it did not follow up to ensure recommended actions were completed timely or to determine if corrective actions taken were effective. For example, as a result of a review in May 2001 at the Atlanta En Route Center, FAA made five recommendations to address deficiencies that led to operational errors. As of April 2002 when we visited this facility, actions to implement two of these five recommendations (which related to improving controller training) were not complete. In FY 2002, this facility's operational errors increased 9 percent from FY 2001.

✈ In response to budget reductions, in March 2002 FAA combined its facility evaluation process and its national reviews of problem facilities into one review. Operational error-related problems identified during these reviews will be entered into a database for tracking purposes. In FY 2002, FAA conducted 34 of these reviews. However, our audit found that the reviews are not always consistent in identifying and tracking problems related to

operational errors. For example, at one facility, FAA cited operational error training as a problem area and will track the resolution of this problem at the national level. However, at another facility where the same deficiency was cited, it was identified as an informational item, which requires no response from the facility and will not be tracked at the national level. At a third facility, this issue was not addressed by the review. All three reviews were performed by different Air Traffic Evaluations Branch field offices.

FAA needs to ensure that its Air Traffic Evaluations Branch field offices are consistent in how they identify and track operational error deficiencies.

## FAA Must Complete Initiatives in the 3-Year Plan for Operational Error Prevention in a Timely Manner

To FAA's credit, in August 2002, FAA and NATCA jointly issued a 3-year plan to prevent operational errors. This plan is a step in the right direction and includes some key actions to reduce operational errors. For example, the plan establishes a National Safety Board that will be responsible for identifying and reviewing "at-risk" facilities. Facilities with significant increases in errors or with significant numbers of high severity errors are considered to be "at risk." The plan also contains initiatives to improve controller training and to determine the root causes of operational errors. One of the initiatives in the plan is to establish a catalog of national, regional, and local initiatives. Facilities will be able to select and implement initiatives from this catalog. A steering committee will track and evaluate the effectiveness of the initiatives in reducing operational errors. However, FAA must ensure that responsible parties are held accountable for completing these initiatives on schedule.

## FAA Must Complete Key Human Factors Initiatives

Since almost 90 percent of operational errors are attributed to human factors issues rather than procedural or equipment deficiencies, it is important that FAA develop initiatives to prevent these types of errors. In FY 2002, FAA initiated two key human factors studies to improve controller performance and better identify the causal factors of errors. In March 2002, FAA completed a prototype memory enhancement training program to evaluate a skills-based approach to develop controller mental skills (e.g., visual processing, concentration, and scanning ability). According to FAA air traffic officials, the study was a success and improved controller mental skills by 16.5 percent in a 6-week period. In a post-evaluation of the pilot training program, participants found the experience made a significant positive impact on their personal performance. Because of funding limitations, FAA is now exploring the feasibility of developing similar training internally so it can be provided nationally.

FAA also initiated a study to develop a human factors technique for analyzing causal factors in operational errors. This study is called the JANUS program. The goal of JANUS is to identify effective solutions to prevent future errors. The program uses a cognitive approach to identify causal factors leading to operational errors, i.e., what was the controller thinking about when the error occurred. It not only evaluates the person, but also the environment, task, and equipment factors that may have contributed to the error. FAA completed its initial tests to validate the methodology used to collect data in March 2003. FAA plans to start field testing in August 2003.

## Recommendations

To reverse the upward trend in operational errors, we recommend that FAA:

1. Reexamine its decision to assign only an 11-point range (90 to 100) for high severity errors and expand the range below the 90-point lower limit so that resources are focused on all errors that pose a very serious safety risk.

2. Take action, in conjunction with NATCA, to rescind applicable provisions of the January 17, 2001 MOU and its April 27, 2001 addendum that revised the training requirements for operational errors and precluded managers from revoking or suspending controller Control Tower Operator licenses and Facility Ratings based on performance deficiencies.

3. Revise FAA Air Traffic Quality Assurance Order 7210.56C to (a) require that controllers who are involved in multiple errors receive training, (b) require that controllers who have moderate and high rated operational errors receive training, and (c) eliminate the provision that precludes managers from revoking or suspending controller Control Tower Operator licenses and Facility Ratings based on performance deficiencies.

4. Establish procedures to monitor, at the national level, the impact that the expanded CIC Program and reduction in the number of supervisors has had on operational errors on a facility-by-facility basis. For those facilities where operational errors have increased when CICs were on duty, FAA should perform a detailed review of the CIC Program to determine if CICs are contributing to the increase. If actions taken do not reverse the upward trend in operational errors while CICs are on duty, then FAA should limit the use of CICs to only the most qualified candidates.

5. Improve national and regional oversight by (a) ensuring a permanent National Program Manager for Quality Assurance is assigned to provide oversight of regional efforts to reduce operational errors, (b) completing the

review and approval of regional operational error reduction programs, (c) conducting reviews of regional quality assurance offices to ensure regions are complying with their plans and are held accountable for addressing facilities in their region that do not show progress at reducing operational errors, and (d) establishing clear guidelines for identifying and tracking operational error-related deficiencies identified during facility evaluations to ensure these deficiencies are treated consistently among FAA's Evaluations offices.

6. Establish a mechanism to ensure responsible parties are held accountable for completing initiatives in FAA's 3-Year Plan for Operational Error Prevention in a timely manner.

7. Expand and implement nationwide the human factors initiative for memory enhancement training.

8. Identify and monitor statistics on the number of operational errors by commercial, general aviation, and military aircraft.

## FAA Comments and Office of Inspector General Response

On March 21, 2003, FAA provided written comments (see Appendix) to our February 26, 2003 draft report. On March 28, 2003, FAA provided revised comments for recommendations 2 and 3 relating to revising training requirements for operational errors.

For recommendations 2 and 3, FAA officials stated that they are currently involved in a review of existing MOUs, which includes re-examining the provisions of the MOU on training requirements for operational errors. We consider FAA's proposed actions to be responsive; however, FAA needs to provide a target date for actual implementation of these recommendations. These recommendations will remain open, and we will monitor FAA's progress in re-examining the MOU and revising training requirements.

For recommendation 5, FAA agreed to improve national and regional oversight, as recommended, and has established a permanent National Program Manager for Quality Assurance. Also, FAA proposed actions to complete its review and approval of regional quality assurance plans by April 15, 2003; review regional efforts to reduce operational errors on a continuous basis; and establish clear guidelines for identifying and tracking operational error-related deficiencies during facility evaluations by May 1, 2003. We consider these actions responsive and this recommendation resolved.

For recommendation 7, FAA agreed to expand and implement the human factors initiative for memory enhancement training. We consider FAA's proposed actions to be responsive; however, FAA needs to provide a target date for actual implementation of memory enhancement training.

FAA's response to recommendation 1, to reexamine how it rates high severity operational errors, does not fully address whether FAA intends to expand the range below the 90-point lower limit. FAA indicated that, while it believes the rating categories for operational errors accurately rate the degree to which separation standards were violated, it will work with FAA's Chief Scientist for Human Factors to scientifically validate the point values. However, FAA did not indicate whether it planned to take any action to expand its range for high severity operational errors. This is important because, as we state in the report, high severity operational errors only have an 11-point range while operational errors rated as moderate have a 50-point range. Within the 50-point range, some operational errors pose a serious safety risk. For example, we identified 65 operational errors rated as moderate where the aircraft involved were within 300 feet vertically, had converging paths, and were within 30 seconds of a midair collision. One of these operational errors involved two commercial airliners, approaching head-on at a closure rate of 460 miles per hour; they were less than 12 seconds from a midair collision when they took evasive action. FAA needs to accurately identify all serious operational errors to ensure that it focuses resources on reducing the most dangerous operational errors. We request that FAA clarify its response to indicate what action it plans to take and provide a target date for the completion of this action.

FAA also needs to clarify its response to recommendation 4, to establish procedures to monitor, at the national level, the impact the expanded CIC Program has on operational errors and to perform detailed reviews of facilities where operational errors have increased while CICs are on duty. FAA stated it agreed with our recommendation and will include CIC information in the agency's operational error causative analysis efforts. However, it is not clear if FAA's causative analysis efforts will include monitoring the impact of the expanded CIC Program on operational errors. Also, FAA did not respond to two elements of recommendation 4, to (a) perform a detailed review of the CIC Program at those facilities where operational errors have increased when CICs were on duty to determine if CICs are contributing to the increase, and (b) limit the use of CICs to only the most qualified candidates if actions taken do not reverse the upward trend in operational errors while CICs are on duty.

As we reported, in order to make additional progress in reducing operational errors, it is important that FAA closely monitor the CIC Program on a facility-by-facility basis. From CY 2000 to CY 2001, operational errors that occurred while a

CIC was on duty increased 46 percent. Until FAA conducts detailed evaluations of those facilities that have significant increases in operational errors while CICs are on duty, the reasons for the increases will not be known.

It is not clear how FAA's proposed actions for recommendation 6, to establish a mechanism to ensure responsible parties are held accountable for completing initiatives in FAA's 3-Year Plan for Operational Error Prevention, will ensure initiatives are completed timely. FAA stated it has made progress in establishing accountability because operational error prevention and goals are tied to Air Traffic Division Managers' appraisals and senior executive compensation packages. While we commend FAA for these actions, it is not clear how these goals are tied to specific initiatives in the 3-Year Plan and whether there is a requirement that the initiatives be completed on schedule. Therefore, we request that FAA provide us additional comments on specific actions it plans to take to hold managers accountable for completing initiatives in its 3-Year Plan on schedule, as well as anticipated completion dates for these actions.

For recommendations 1, 4, and 6, FAA's proposed actions do not address the intent of our recommendations or are unclear. Therefore, we are requesting that FAA provide additional information on their proposed actions.

Recommendation 8, to identify and monitor statistics on the number of operational errors by commercial, general aviation, and military aircraft, was not included in our February 26, 2003 draft report. Therefore, we are requesting that FAA provide comments on this new recommendation. If you concur, please provide the specific action taken or planned and a target date for completion. If you nonconcur, please provide your rationale.

# Finding B. Actions Are Needed to Reduce Runway Incursions Further

FAA continued to focus on reducing runway incursions and has made progress this past year. In June 2001, FAA established a system to categorize runway incursions into four levels of accident risk to target reduction efforts on the most serious incursions. The four risk levels described in part are:

- A: barely avoid a collision,
- B: significant potential for a collision,
- C: ample time and distance exists to avoid a potential collision, and
- D: little or no risk of a collision exists.

In addition, FAA's full-time regional runway safety managers, appointed in October 2000, conducted a total of 183 safety evaluations of runways at specific airports in FYs 2001 and 2002. The safety evaluations are used to identify runway-specific problems that may lead to runway incursions and to identify actions to correct these problems. The actions are entered into a national database, and the Office of Runway Safety uses the database as a management tool to monitor regional progress toward completing actions on schedule.

FAA missed its FY 2001 goal of no more than 243 runway incursions by 67 percent, with 407 incursions.[18] In FY 2002, runway incursions decreased to 339, or about 17 percent. For FY 2002, FAA revised its goal to focus on the most serious incidents. Its goal was to have no more than 53 runway incursions in the two highest risk categories (Categories A and B). As shown in Figure 6, FAA met its FY 2002 goal with 37 such incursions, down 30 percent from FY 2001. However, an average of at least one high risk runway incursion every 10 days is still too many.

## Figure 6—Category A and B Runway Incursions FYs 1998-2002



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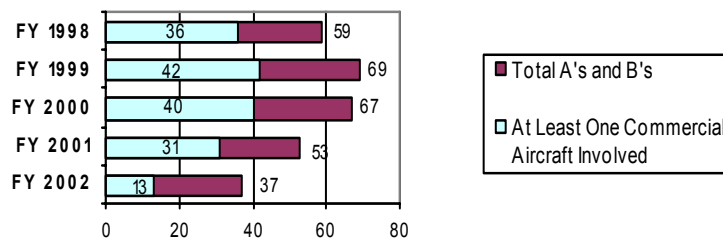
[18] Starting in October 2000, FAA changed its goal for reducing runway incursions from a calendar year to a fiscal year basis. After a record high of 431 runway incursions in CY 2000, runway incursions decreased to 383 in CY 2001.

In the first 5 months of FY 2003, runway incursions *increased* 18 percent from 114 to 135 compared to the same period in FY 2002. During this same 5-month period, the 2 highest risk categories of runway incursions decreased from 17 to 10 compared to the same period in FY 2002. While the progress in reducing the most serious runway incursions is encouraging, it is important that FAA take additional actions to further reduce the number and safety risk of runway incursions, especially since FAA projects that air traffic operations will return to pre-September 11th growth patterns between 2005 and 2007.

The following examples demonstrate the seriousness of runway incursions.

➢ In April 2002 at the Atlanta Airport, a Piper Cherokee general aviation aircraft taxied onto an active runway without authorization and was narrowly missed by a Boeing 737 as it was taking off.

➢ In February 2002, an Airbus 319 was instructed to taxi to and stop short of an active runway at Baltimore-Washington Airport. Instead, the Airbus crossed the active runway without authorization. A McDonnell Douglas 11 (MD-11) taking off on the same runway aborted the takeoff roll when the pilot observed the Airbus crossing in front of him. The MD-11 was able to stop just 500 feet from the Airbus.

While progress has been made in reducing runway incursions this past year, the numbers are still much too high. In FY 2002, on average, almost one runway incursion occurred every day. Even though serious runway incursions decreased 30 percent in FY 2002, an average of one serious runway incursion every 10 days is still too many. Also, 13 of these serious incursions involved at least 1 commercial aircraft, or about 1 each month. Because commercial aircraft are likely to carry many passengers, the risk that one collision with a commercial aircraft could occur each month is still very serious.

According to the Director of the Office of Runway Safety, "the decrease in runway incursions in FY 2002 must not lead to complacency. The number of fatalities from a single runway collision could be catastrophic. Therefore, improvement is essential to reduce the risk." In our opinion, FAA has appropriately focused its resources on reducing runway incursions and has made progress. However, FAA can make even more progress if it completes actions to implement recommendations in our June 2001 report (see Exhibit F) and continues to aggressively pursue ways to reduce runway incursions further.

## Analysis of the Decrease in Runway Incursions

We analyzed the decrease in runway incursions from FYs 2001 to 2002 (407 to 339) to determine what impact the reduction in air traffic operations may have had

on the decrease in incursions. During this same time period, operations at *towers* decreased about 1.3 million operations, or about 2 percent. We performed a statistical correlation analysis[19] on a monthly basis for FY 2001 and FY 2002, comparing total tower operations to runway incursions, and concluded there was a positive correlation. In other words, as tower operations decreased nationwide, runway incursions decreased. Conversely, the more tower operations there are nationwide, the more opportunities exist for a runway incursion or runway accident.

However, as stated in FAA's June 2002 Runway Safety Report,[20] traffic volume is not the only factor contributing to the potential for runway incursions. Airport-specific factors also influence the potential for a runway incursion. For example, we performed a statistical correlation analysis on a facility basis for 13 airports with the most runway incursions in either FY 2001 or FY 2002 comparing the number of tower operations to runway incursions[21] and concluded that there was no correlation for these 13 airports. However, as FAA runway safety officials indicated, other factors contributed to the decrease in runway incursions at these airports.

For instance, the decrease in runway incursions at 3 of the 13 airports accounted for 31 percent of the total decrease nationwide (21 out of a total decrease of 68 incursions from FY 2001 to FY 2002): John Wayne Airport, Orange County, California; Fort Lauderdale Executive Airport, Florida; and Buchanan Field, Concord, California. Runway safety officials attributed the decrease in runway incursions at these airports to national, regional, and site-specific initiatives to reduce runway incursions. For example, FAA conducted runway safety reviews at these three airports during FY 2001 or FY 2002. As a result, improvements, such as better runway/taxiway markings, signs, and lighting systems, were made at these airports to prevent runway incursions. In addition, pilot education programs were implemented.

## Actions to Implement Technological Solutions to Prevent Runway Incursions Are Still Needed

Although FAA has made progress in implementing some technologies, other technologies are still needed to reduce runway incursions further.

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[19] A statistical correlation analysis measures the extent to which a relationship exists between two or more variables. We used SPSS statistical software and plotted the number of tower operations to the number of runway incursions to evaluate the correlation, or relationship, that these two variables had with one another.

[20] "FAA Runway Safety Report - Runway Incursion Trends at Towered Airports in the United States," CY 1998 – CY 2001, dated June 2002.

[21] Runway incursions decreased at 10 of these airports and increased at 3 airports.

➤ In 2001, after 10 years of development and $86 million in cost overruns, FAA began commissioning the Airport Movement Area Safety System (AMASS) to alert controllers of potential collisions at the 34 largest airports. As of December 31, 2002, FAA commissioned 25 systems at 24 airports, and plans to commission systems at the remaining 10 airports by the end of 2003. However, FAA has experienced significant delays, 7 to 10 months, in its commissioning schedule for four airports—Cleveland, Minneapolis, Kansas City, and Denver. Most of the delays were due to the need to make software changes, fix equipment technical problems, or make physical changes to the airport surroundings to remove obstructions that blocked radar transmissions. However, at Cleveland, part of the delay was due to the lack of funds to train equipment technicians. FAA has addressed these problems and must make sure that resources are available to limit future delays. *However, AMASS will not prevent runway incursions in all situations and does not directly alert pilots of potential collisions; therefore, other technological solutions are still needed.*

➤ FAA needs to complete its efforts to identify and *implement* low-cost technologies and solutions at airports with continued runway incursion problems. As recommended in our June 2001 report, FAA completed its initial review of six low-cost emerging technologies in July 2002 and recommended that three of the technologies (ground markers, runway status lights, and smart boards)[22] be further evaluated. FAA's next step is to ensure these low-cost technologies are advanced to high risk airports, as recommended. Also, as recommended, FAA conducted reviews at the 13 problem airports that had 10 or more runway incursions over a 4-year period (1997 to 2000) but were not scheduled to receive any technology plus 3 additional airports FAA identified for review. (See Exhibit D for an updated list of airports with 10 or more runway incursions from 1999 to 2002.) FAA published its findings and recommendations from these reviews on January 29, 2003, in its Runway Incursion Airport Assessment Report. FAA's next step is to ensure that actions to implement these recommendations are completed timely. In addition, based on our updated list of airports with 10 or more runway incursions, there are 4 additional problem airports[23] that have no technology scheduled. FAA should conduct technology reviews at these four airports.

➤ Because 56 percent of runway incursions in FY 2002 were caused by pilots, it is important that FAA also expedite technologies for pilots, as we

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[22] Ground markers transmit audible messages to the pilot regarding the runway status, i.e., alert the pilot if the runway is occupied. Runway status lights provide the pilot a visual signal, similar to a traffic light, regarding the runway status. Smart boards are electronic bulletin boards that are placed at taxiway/runway intersections to provide pilots with advisory messages.

[23] These airports are: Denver/Jeffco, Colorado; Prescott, Arizona; Fresno, California; and Palm Beach, Florida.

recommended in our June 2001 report. However, FAA and the aviation industry have not made a decision to expedite technologies, such as the in-cockpit surface moving map displays, that may have significant potential for reducing runway incursions caused by pilots. According to FAA officials, efforts to expedite these technologies have been slowed due to the economic slowdown of the airline industry, which became more pronounced after September 11th. FAA officials stated that because major investments in security are being made while revenue is down, most airlines have no budget for new avionics. In an effort to expedite moving map technology, FAA is working with the aviation industry in developing a portable surface moving map display that can be used with an Electronic Flight Bag.[24] In addition, FAA is moving forward with developing 78 airport surface moving maps by the end of 2004 so the maps will be available once the airlines are able to install the technology needed in the cockpit.

## Actions to Improve Program Accountability Have Not Been Completed

As we reported in June 2001, improvements in program oversight were needed because initiatives to reduce runway incursions were not completed on time, completed initiatives were not evaluated to determine if they were working, and regional efforts were not periodically assessed to ensure that progress is being made to reduce runway incursions at airports. In August 2001, FAA established a mechanism to improve regional accountability by establishing a database for tracking and following up on recommendations made during runway safety reviews of specific airports. FAA Headquarters and regional offices use the database to ensure recommended actions are completed. FAA is also using the data in this database along with its runway incursion database to measure the effectiveness of these efforts.

Runway safety officials believe FAA's ability to meet future milestones in implementing runway safety initiatives will be improved with the implementation of its 2002-2004 Runway Safety Blueprint, issued in July 2002. In developing the Blueprint, FAA coordinated with and obtained approval of all its lines of business. The Blueprint identifies FAA's goals and initiatives to reduce runway incursions, assigns a lead organization responsibility for each initiative, and requires lead organizations to prepare an implementation plan for each initiative.

However, we are not convinced that actions taken to date will improve program accountability at the national level. Contrary to our recommendation, FAA's

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[24] Electronic Flight Bags can display a variety of aviation data, including runway maps, which in the past were obtained from paper documents or an airline's flight dispatch function.

Runway Safety Program Director still has no authority to ensure that initiatives undertaken by various FAA lines of business are completed on schedule and does not provide input on individuals' performance appraisals and bonuses. As previously reported, many initiatives to reduce runway incursions over the years were not completed on schedule.

For instance, in August 2000, FAA identified 10 near-term initiatives that were to be completed by early 2001. Seven of these 10 initiatives were completed 6 to 21 months behind schedule. For example, one of the initiatives was to enhance operational tower controller training. The initiative was originally scheduled to be completed no later than December 31, 2000, but was not completed until September 2002, 21 months later.

In our opinion, the process established by FAA to have the Office of Runway Safety monitor the progress of other lines of business in meeting their milestones will not work if the Office of Runway Safety has no authority over the lines of business. FAA needs to establish a mechanism at a level where appropriate actions and priorities can be directed above the lines of business. Without such a mechanism, there is no assurance that actions in this Blueprint will be completed any more timely than actions contained in FAA's four prior action plans issued over the last 10 years.

## Recommendations

FAA must move expeditiously to complete recommendations made in our June 2001 report to reduce runway incursions further. Specifically, FAA needs to (1) advance low-cost technologies to high risk airports; (2) expedite technologies, such as in-cockpit surface moving map displays, to aid pilots in reducing runway incursions; and (3) improve program accountability. See Exhibit F for details. In addition, we are making two new recommendations. Specifically, FAA should:

1. Implement recommendations in its Runway Incursion Airport Assessment Report, published January 29, 2003, made as a result of technological reviews of the 13 problem airports identified in our 2001 report.

2. Conduct reviews at the 4 airports that had 10 or more runway incursions over the 4-year period 1999 to 2002 to determine whether technological solutions are needed.

## FAA Comments and Office of Inspector General Response

On March 21, 2003, FAA provided written comments (see Appendix) to our February 26, 2003 draft report. FAA indicated that actions are being taken to

address recommendations in our June 2001 report and provided us timeframes for completion of these actions. Regarding our previous recommendation to improve program accountability, we closed this recommendation based on FAA's response that the Office of Runway Safety reports quarterly to the FAA Administrator on the progress that the lines of business have made in accomplishing their runway safety objectives. We will continue to monitor FAA's progress in completing the remaining two recommendations from our June 2001 report.

Regarding our recommendations from this report, FAA concurred with recommendation 1, to implement recommendations in its Runway Incursion Airport Assessment Report made as a result of technological reviews of 16 problem airports. FAA indicated that it is working at the field level to coordinate improvements to signs, surface markings, and security. Of the 16 airports, FAA has identified 6 airports for improved airport marking and signs, and it indicated that work at 4 of these airports has been completed. FAA is also working at other airports to test improvements to surface operations. FAA plans to complete this work in 2004 and begin to work at higher capacity commercial and general aviation airports in 2005.

For recommendation 2, FAA stated that work has already been directed to conduct technology reviews at the 4 airports with 10 or more runway incursions over the 4-year period 1999 to 2002. FAA indicated the work will be completed in 2003.

When fully implemented, these actions should help further reduce runway incursions. Accordingly, we consider FAA's proposed actions to be responsive, and we consider these recommendations resolved.

# EXHIBIT A.  ORGANIZATIONS VISITED OR CONTACTED

We conducted site visits and interviewed air traffic managers and controllers at FAA Headquarters in Washington, D.C.; four FAA regional offices; and nine air traffic control facilities listed below.  We also interviewed runway safety managers at three regional offices.

## FAA REGIONAL OFFICES

Eastern, Jamaica, NY
Great Lakes, Des Plaines, IL
Southern, College Park, GA
Western-Pacific, Hawthorne, CA

## FAA FACILITIES

Atlanta en route center[1]
Chicago en route center
Indianapolis en route center
Los Angeles en route center
New York (stand-alone) TRACON[2]
Atlanta TRACON/tower[3]
Baltimore-Washington TRACON/tower
Chicago-O'Hare tower
Philadelphia TRACON/tower

We also interviewed representatives from NATCA and NTSB.

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[1] *Air Route Traffic Control Centers (ARTCC or en route facilities)* provide air traffic control (ATC) services for the en route phase of flights, generally above 10,000 feet.

[2] *Terminal Radar Approach Control (TRACON)* facilities provide ATC approach control services within about 5 to 40 miles of an airport.

[3] *Control towers (towers)* provide ATC services within about 5 miles of an airport (including take-offs, landings, and ground control).

# EXHIBIT B.  STATISTICAL CORRELATION ANALYSIS OF OPERATIONAL ERRORS BY FACILITY

For the 27 facilities that had the most operational errors in FY 2002 as shown in Exhibit C, 24 had decreases in air traffic operations.  Twelve of these 24 facilities had increases in operational errors and 12 had decreases.  However, our statistical correlation analysis indicated that there was a correlation between the number of air traffic operations and operational errors.

To illustrate, the chart below shows that of the 11 facilities that had a 5 percent or more decrease in operations, 5 facilities had a **decrease** in operational errors, and 6 facilities had an **increase** in operational errors.  The reason our analysis still showed a correlation between errors and operations is that the total number of operational errors and corresponding increases for the latter six facilities were small when compared to the five facilities whose errors decreased.  For example, only 1 of these 6 facilities had more than 20 operational errors, and the biggest increase in errors at these 6 facilities was only 5.

## *Facilities With a 5 Percent or More Reduction in Operations*

| Facility | Percent Decrease in Operations | FY 2001 Errors | FY 2002 Errors | Decrease/ Increase in Errors |
|---|---|---|---|---|
| **Decreases in Errors** | | | | |
| Washington Center | 7 % | 92 | 60 | -32 |
| Los Angeles Center | 7 % | 52 | 28 | -24 |
| Boston Center | 6 % | 25 | 16 | -9 |
| Oakland Center | 5 % | 23 | 22 | -1 |
| New York TRACON | 5 % | 62 | 32 | -30 |
| | | | | |
| **Increases in Errors** | | | | |
| Minneapolis TRACON | 8 % | 6 | 8 | +2 |
| Miami TRACON/Tower | 7 % | 11 | 12 | +1 |
| Dulles TRACON/Tower | 7 % | 7 | 9 | +2 |
| Detroit TRACON | 5 % | 3 | 8 | +5 |
| New York Center | 5 % | 41 | 44 | +3 |
| Houston Center | 5 % | 9 | 14 | +5 |

# EXHIBIT C. TOP 25 RANKINGS OF FACILITIES WITH OPERATIONAL ERRORS FOR FY 2002

| Rank | Facility | Number of Errors FY 2001 | Number of Errors FY 2002 | Percent Increase/ Decrease FY01/02 |
|---|---|---|---|---|
| 1 | Cleveland ARTCC | 64 | 68 | 6% |
| 2 | **Indianapolis ARTCC** | **39** | **66** | **69%** |
| (tie) | **Chicago ARTCC** | **72** | **66** | **-8%** |
| 4 | **Atlanta ARTCC** | **56** | **61** | **9%** |
| 5 | Washington ARTCC | 92 | 60 | -35% |
| 6 | New York ARTCC | 41 | 44 | 7% |
| 7 | Memphis ARTCC | 37 | 38 | 3% |
| 8 | Fort Worth ARTCC | 28 | 36 | 29% |
| 9 | **New York TRACON*** | **62** | **32** | **-48%** |
| 10 | Denver ARTCC | 24 | 31 | 29% |
| 11 | **Los Angeles ARTCC** | **52** | **28** | **-46%** |
| 12 | Jacksonville ARTCC | 36 | 27 | -25% |
| (tie) | Kansas City ARTCC | 32 | 27 | -16% |
| 14 | Miami ARTCC | 26 | 24 | -8% |
| 15 | Oakland ARTCC | 23 | 22 | -4% |
| 16 | Albuquerque ARTCC | 19 | 17 | -11% |
| 17 | Boston ARTCC | 25 | 16 | -36% |
| 18 | Houston ARTCC | 9 | 14 | 56% |
| 19 | **Philadelphia TRACON/Tower*** | **17** | **13** | **-24%** |
| 20 | Miami TRACON/Tower* | 11 | 12 | 9% |
| (tie) | Minneapolis ARTCC | 18 | 12 | -33% |
| 22 | Salt Lake ARTCC | 21 | 11 | -48% |
| 23 | Washington-Dulles TRACON/Tower* | 7 | 9 | 29% |
| (tie) | **Atlanta TRACON/Tower*** | **10** | **9** | **-10%** |
| 25 | Detroit TRACON* | 3 | 8 | 167% |
| (tie) | Minneapolis TRACON* | 6 | 8 | 33% |
| (tie) | Anchorage ARTCC | 5 | 8 | 60% |
| | | | | |
| | Total Top 25 ranking (27 facilities) | 835 | 767 | -8% |
| | | | | |
| | Nationwide Total | 1,194 | 1,061 | -11% |

Note: Facilities in **bold face** were visited during our review.
Shaded facilities (13) made no progress in reducing errors from FY 2001 to FY 2002.
* TRACON and tower facilities are commonly referred to as *terminals*. Some TRACON and tower facilities are combined into one facility while others are separate facilities. Therefore, it is important to know whether or not an airport has both a TRACON and a tower or only a tower when comparing the number of operational errors with those of other airports.

# EXHIBIT D.  AIRPORTS WITH 10 OR MORE RUNWAY INCURSIONS FROM 1999 TO 2002

| Number | Airport/Location | Total Incursions Over 4 Years | AMASS Scheduled/ Commissioned** | ASDE-X*** Scheduled | Technology Review Conducted |
|---|---|---|---|---|---|
| 1 | N. Las Vegas, NV | 35 | | | 8/01 |
| 2 | Ft. Lauderdale Exec., FL | 34 | | | 10/01 |
| 3 | Los Angeles, CA | 32 | **9/01** | FY 05 | |
| 4 | Orange County, CA | 31 | | FY 06 | |
| 5 | St. Louis, MO | 27 | **12/01** | FY 05 | |
| 6 | Long Beach, CA | 26 | | | Ongoing |
| 7 | Concord, CA | 24 | | | 3/02 |
| 8 | Phoenix, AZ | 24 | | FY 04 | |
| 9 | Chicago O'Hare, IL | 22 | **11/01** | FY 05 | |
| 10 | Boston, MA | 20 | **1/02** | | |
| 11 | Dallas-Ft. Worth, TX | 18 | 3/03 | FY 05 | |
| 12 | San Diego/Mont., CA | 18 | | | 3/02 |
| 13 | San Francisco, CA | 17 | **6/01** | | |
| 14 | Crystal, MN | 15 | | | 6/02 |
| 15 | Merrill Field, AK | 15 | | | 10/01 |
| 16 | Las Vegas, NV | 14 | **12/02** | | |
| 17 | Newark, NJ | 14 | **2/02** | | |
| 18 | Atlanta, GA | 14 | **4/02** | FY 05 | |
| 19 | **Denver/Jeffco, CO*** | 13 | | | |
| 20 | Minneapolis, MN | 13 | 3/03 | | |
| 21 | Santa Barbara, CA | 13 | | | 3/02 |
| 22 | Seattle, WA | 13 | **11/01** | | |
| 23 | Teterboro, NJ | 13 | | | 6/02 |
| 24 | Centennial, CO | 12 | | | 6/02 |
| 25 | Daytona Beach, FL | 12 | | | 10/01 |
| 26 | **Prescott, AZ*** | 12 | | . | |
| 27 | Midway, IL | 11 | | FY 06 | |
| 28 | **Fresno, CA*** | 11 | | | |
| 29 | LaGuardia, NY | 11 | **12/02** | | |
| 30 | San Juan, PR | 11 | | FY 07 | |

| Number | Airport/Location | Total Incursions Over 4 Years | AMASS Scheduled/ Commissioned** | ASDE-X*** Scheduled | Technology Review Conducted |
|---|---|---|---|---|---|
| 31 | Salt Lake City, UT | 11 | **11/01** | | |
| 32 | Detroit Metro, MI | 10 | **6/01** | | |
| 33 | Milwaukee, WI | 10 | | FY 03 | |
| 34 | J F Kennedy, NY | 10 | **4/02** | | |
| 35 | Knoxville, TN | 10 | | | 12/01 |
| 36 | **Palm Beach, FL*** | 10 | | | |
| 37 | San Jose, CA | 10 | | FY 05 | |
| 38 | Providence, RI | 10 | | FY 04 | |

Note: The shaded airports were not scheduled to receive any technology prior to our June 2001 report. FAA has since completed technological reviews at these airports and published its findings and recommendations regarding these airports on January 29, 2003. Flying Cloud Airport, Minnesota, and Deer Valley, Arizona, were also identified as 2 of the 13 problem airports in our June report based on 1997 to 2000 runway incursion data. A technology review was performed at these airports in 2001 and 2002, respectively. In addition to the 13 airports identified in our 2001 report, FAA conducted technology reviews at airports in Fairbanks, Alaska, Sarasota, Florida, and Knoxville, Tennessee.

\* **Bolded airports** are not currently scheduled to receive any technology
\*\* **Bolded date** means that AMASS has been commissioned at that airport.
\*\*\* ASDE-X—Airport Surveillance Detection Equipment-Model X

# EXHIBIT E. STATUS OF DECEMBER 2000 RECOMMENDATIONS REGARDING OPERATIONAL ERRORS

| RECOMMENDATIONS TO BE IMPLEMENTED | FAA'S CURRENT STATUS AS OF FEBRUARY 28, 2003 |
|---|---|
| 1. Develop a method to determine the severity, or collision hazard, of operational errors that occur in the air so it can focus its resources and take action based on the severity of these incidents. | 1. Closed: FAA implemented the Operational Error Severity Rating System on April 27, 2001. |
| 2. Require regions to (a) prepare and periodically update operational error prevention plans based on the facility assessments which identify specific actions needed to reduce operational errors, and (b) follow up to ensure deficiencies identified during regional reviews are corrected. | 2. Closed: FAA Notice (N7210.514), issued on August 9, 2001, directed regional offices to review existing regional quality assurance (QA) programs and develop new or revise existing orders. |
| 3. Require the Air Traffic Services Evaluation and Investigations Staff to review and approve regional operational error prevention plans, complete the national reviews of facilities with increasing trends in operational errors, and ensure that recommendations resulting from the national reviews are implemented and effective at reducing operational errors. | 3. Closed: FAA Notice (N7210.514) issued on August 9, 2001, described Headquarters' oversight to include reviews of regional and selected facility QA programs to ensure compliance with this Notice. In FY 2001, FAA completed 23 national reviews of facilities with increasing trends in operational errors. Despite this guidance, we found that the review and approval of regional plans were not completed and no follow-up mechanism was in place to ensure that recommended corrective actions were taken and effective. New recommendations have been made in this report. |
| 4. Implement NTSB's recommendation to extend the retention period for voice communication and radar tapes from 15 to 45 days. | 4. Closed: FAA officials believed it would create a storage problem for facilities without updated technology to extend their tape retention period. However, FAA agreed to immediately retain voice tapes and radar data for 45 days of all known or suspected incidents to facilitate investigations and analysis of these incidents. |

# EXHIBIT F. STATUS OF JUNE 2001 RECOMMENDATIONS REGARDING RUNWAY INCURSIONS

| RECOMMENDATIONS TO BE IMPLEMENTED | FAA'S CURRENT STATUS AS OF FEBRUARY 28, 2003 |
|---|---|
| 1. Expedite the use of in-cockpit surface moving map displays and Automatic Dependent Surveillance - Broadcast (ADS-B) for use by pilots in reducing runway incursions. FAA should determine if its process to certify new equipment for safe operation could be accelerated to expedite these technologies. FAA should also issue an Advanced Notice of Proposed Rulemaking to obtain comments from the airline industry and general aviation community on implementing in-cockpit moving map displays and ADS-B. | 1. Open:* A decision has not been made to expedite surface moving map and ADS-B technologies that will assist pilots in preventing runway incursions. A joint industry and Government team is developing an implementation plan, but actual implementation of moving map displays is uncertain due to the financial impact on the airlines of reduced air travel since early 2001. Meanwhile, FAA is working with industry to develop a portable surface moving map. These maps can be used with Electronic Flight Bags, which display aviation data that was previous obtained from paper documents or an airline's flight dispatch function. |
| 2. Develop a realistic schedule to commission the remaining 32 AMASS sites. The current schedule is unlikely to be met unless Airway Facilities resources are adequate to commission the remaining sites and time is allowed to ensure controller acceptance of AMASS. | 2. Closed: FAA revised its schedule on September 27, 2001. |
| 3. Determine whether some airport needs for Airport Surface Detection Equipment, Model X (ASDE-X) can be met by radar alone. After airport needs are identified, FAA should revise its ASDE-X cost and schedule baseline. | 3. Closed: FAA completed its review on September 5, 2001, and determined that a full ASDE-X system was needed for each airport. |
| 4. Complete its evaluations of the six emerging technologies it has identified to assist controllers and pilots in reducing runway incursions, and advance the ones most likely to reduce runway incursions quickly to high-risk airports. | 4. Open:* FAA completed its initial evaluation and demonstration of six emerging, low-cost technologies. FAA issued a report of its findings and recommendations in July 2002 and recommended that three of the six low-cost technologies be further evaluated. |

| | |
|---|---|
| 5. Conduct reviews at the 13 airports that had 10 or more runway incursions over the past 4 years to determine whether technological solutions are needed. [In our June 2001 report, we identified that 13 of the 37 airports with 10 or more runway incursions from CY 1997 to CY 2000, did not have AMASS or ASDE-X scheduled for implementation.] | 5. Closed: FAA has completed technology reviews at these 13 airports. FAA published its findings and recommendations on January 29, 2003. |
| 6. Provide the Runway Safety Program Director with authority to ensure that employees from other lines of business complete tasks to reduce runway incursions on time. An accountability mechanism, such as directing the Runway Safety Program Director to provide input on individuals' performance appraisals and bonuses, should be developed to hold people involved with runway safety accountable for completing initiatives within established milestones. | 6. Closed:* FAA identified new runway incursion objectives in its 2002-2004 Runway Safety Blueprint, issued in July 2002. Runway Safety Office officials believe FAA's ability to meet future milestones in implementing runway safety objectives will be improved with the implementation of its Blueprint and the process it will use to monitor the status of objectives in the plan. However, FAA did not provide the Runway Safety Program Director with the authority or a mechanism to ensure that employees from other lines of business complete tasks to reduce runway incursions on time. |
| 7. Measure whether initiatives are effective in addressing the causes of runway incursions, and periodically assess regional efforts to ensure that progress is being made to reduce runway incursions at specific airports. | 7. Closed: In August 2001, FAA established a database for tracking and following up on recommendations made during runway safety reviews of specific airports. This database, along with FAA's runway incursion database, is used to track the effectiveness of initiatives at specific airports. FAA also uses the database, weekly telecons, and quarterly program reviews to monitor regional activity and progress. |

\* FAA's March 21, 2003 response to our report identified additional actions FAA has taken to address recommendations 1, 4, and 6 from our June 2001 report. Regarding recommendation 6, to improve program accountability, we closed this recommendation based on FAA's response that the Office of Runway Safety reports quarterly to the FAA Administrator on the progress that the lines of business have made in accomplishing their runway safety objectives. See pages 42 through 44, FAA response numbers 1, 2, and 3 for details.

# EXHIBIT G.  MAJOR CONTRIBUTORS TO THIS REPORT

**THE FOLLOWING INDIVIDUALS CONTRIBUTED TO THIS REPORT.**

| Name | Title |
| --- | --- |
| Richard Kaplan | Program Director |
| Mary E. (Liz) Hanson | Project Manager |
| James Madden | Senior Auditor |
| Kevin George | Analyst |
| Curt Boettcher | Analyst |
| Jeannette McDonald | Analyst |
| Petra Rose | Senior Statistician |
| Eric Whipkey | Statistician |
| Shirley Murphy | Editor |

# APPENDIX. MANAGEMENT COMMENTS

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

# Memorandum

Subject: **INFORMATION:** Draft Report on Operational Errors and Runway Incursions:  Recent Progress Has Been Made, But the Number of Incidents is Still Too High Considering the Serious Safety Risks

Date: March 21, 2003

From: Associate Administrator for Air Traffic Services, ATS-1

Reply to Attn. of:

To: Assistant Inspector General for Aviation Audits

This memorandum is in response to the second draft report received on February 27, 2003, entitled "Operational Errors and Runway Incursions:  Recent Progress Has Been Made, but the Number of Incidents Is Still Too High Considering the Serious Safety Risks."

We acknowledge the findings and recommendations in this draft report and have included our comments as two separate attachments.  Many of your recommendations have programmatic and budgetary impacts.  As you are aware, we are in the midst of creating a new strategic plan and prioritizing our budget.  Both of which may impact our reply to the final report.

Steven J. Brown

Attachments

**FAA Comments Regarding Operational Errors To Draft OIG Report:** Operational Errors And Runway Incursions: Recent Progress Has Been Made, But The Numbers Of Incidents Is Still Too High Considering The Serious Safety Risks

1) **Reexamine the decision to assign only an 11-point range (90 to 100) for high severity errors and expand the range below the 90-point lower limit so that resources are focused on all errors that pose a very serious safety risk.**

   FAA Response: The current point values associated with the severity ratings were based on scientific assessment. Initially, three categories were developed and operational errors were rated as High Moderate or Low. These categories were further refined into: A, High Severity. B Moderate Severity, uncontrolled. C, Moderate Severity, controlled and D, Low Severity. While we believe these categories accurately rate the degree to which a separation standard was violated, we will work with Dr. Mark Rodgers (FAA's Chief Scientist for Human Factors) to scientifically validate the point values.

2) **Take action in conjunction with NATCA, to rescind applicable provisions of the January 17, 2001 MOU and its April 27, 2001 addendum that revised the training requirements for operational errors and precluded managers from revoking or suspending controller Control Tower Operator licenses and Facility Ratings based on performance deficiencies.**

   (See attached comments on page 46 provided by FAA on March 28, 2003)

3) **Revise FAA Air Traffic Quality Assurance Order 7210.56C to:**
   a. **require that controllers who are involved in multiple errors receive training,**
   b. **require that controllers who have moderate and high rated operational errors receive training, and**
   c. **eliminate the provision that precludes managers from revoking or suspending controller Control Tower Operator licenses and Facility Ratings based on performance deficiencies**

   (See attached comments on page 46 provided by FAA on March 28, 2003)

4) **Establish procedures to monitor, at the national level, the impact that the expanded CIC program and reduction in the number of supervisors has had on operational errors on a facility-by-facility basis.**

   FAA Response: We agree with the recommendation and will include it in the agency's OE causative analysis efforts.

5) **Improve national and regional oversight by:**

    a.  **ensuring a National Program Manager for Quality Assurance is assigned to provide oversight of regional efforts to reduce operational errors,**

    b.  **completing the review and approval of regional operational error reduction programs,**

    c.  **conducting reviews of regional quality assurance offices to ensure regions are complying with their plans and are held accountable for addressing facilities in their regions that do not show progress at reducing operational errors, and**

    d.  **establishing clear guidelines for identifying and tracking operational error related deficiencies identified during facility evaluations to ensure these deficiencies are treated consistently among FAA's Evaluation offices.**

FAA Response:

    a.  We agree with this recommendation and we have established a permanent National Program Manager for Quality Assurance (AAT-20). Although the individual was temporarily detailed to another critical position, the detail was completed in November 2002 and we have resumed the function of providing oversight of regional efforts to reduce operational errors.

    b.  We are completing the review and approval of regional Quality Assurance orders and programs designed to reduce operational errors. We estimate that the review of all regional QA orders will be completed by April 15, 2003.

    c.  The National Program Manager for Quality Assurance will continue to conduct reviews of regional quality assurance orders as well as regional OE reductions plans and efforts. These QA Orders and OE reduction plans will also be maintained in the appropriate Evaluation Branch Office and used during facility evaluations. Regional Air Traffic Division Managers are held accountable as a portion their performance appraisal is based on operational error reduction and preventions.

    d.  AAT-20 concurs with the recommendation of consistency among the three branches. In an effort to establish clear guidelines, a revision to the Evaluations Order (7010.1) is currently in coordination. The changes will establish an evaluation checklist that is focused on system safety, system efficiency and system management. We plan to have this order in place by May 1, 2003. Additionally, AAT-20 is revising the Standard Operating Procedures (SOP) to align the SOP with the revised order and to provide

for standardization among the branch offices.  The changes to the SOP should also be effective by May 1, 2003.

6) **Establish a mechanism to ensure responsible parties are held accountable for completing initiatives in FAA's 3-year Plan for Operational Error Prevention in a timely manner.**

FAA Response:  We have made progress in establishing accountability for prevention of operational errors.  For example, a portion of each Air Traffic Division Manager's performance appraisal is based on operational error reduction/prevention.  Additionally, the goal of reducing operational errors is tied to the compensation package for senior executives in Air Traffic Services.  The facility evaluation process is also under revision and should be completed by May 1, 2003.  The revision will more closely align the facility evaluation process with the executive compensation objectives in areas of system safety, system efficiency and system management.

7) **Expand and implement nationwide the human factors initiative for memory enhancement training.**

FAA Response: We concur with the OIG recommendation and believe that significant reductions in operational errors may be achieved as a result of a better understanding of Human Factors and through the development of new training initiatives focused on enhancing cognitive skills such as memory and awareness. Two efforts are currently underway:

1) The JANUS (Human Factors) procedure has been beta tested using actual operational errors.  JANUS was developed by the Civil Aeronautical Medical Institute (CAMI) and is a tool that may provide better understanding of operational error causal factors and facilitate development of appropriate training. FAA has beta tested JANUS in over 70 actual operational errors; validation of the tool is expected in March/April, 2003.

2) National Air Traffic Professionalism (NATPRO) is a new training approach designed to exercise the mind to improve concentration rather than relying solely on knowledge-based intervention.   This project will utilize an interactive computer based cognitive skills program that facilitates skill building and increases controller awareness of mental skills affecting performance.  FAA is identifying two facilities to beta test the concept of using an "Awareness Seminar" coupled with computer skills training to enhance the learning process on the subject of concentration.  Our goal is to increase the controller's awareness of mental skills affecting performance and to involve them in an interactive program that promotes learning in this area.

Some of the functions this type of training will address are awareness, memory improvement, performance management and coaching. The following represents the progress of this project.

- Feasibility study completed on September 15, 2002
- Seminar/Practicum Core Framework completed December 12, 2002
- Product roll-out was completed on March 20, 2003
- Phase four will be limited field delivery (beta testing the product) expected to begin in April 2003.
- Beta testing will include site preparation, installation of the NATPRO programs in the skill lab, a coach's clinic and finally a Pilot/Metric evaluation.

It should be noted that funding to support the development and evaluation of these tools is crucial to the success of this outcome.

<u>**FAA Response To Runway Incursion Recommendations In Draft OIG Report**</u>:
<u>Operational Errors And Runway Incursions: Recent Progress Has Been Made, But The</u>
<u>Numbers Of Incidents Is Still Too High Considering The Serious Safety Risks</u>

The FAA concurs with the OIG recommendations regarding runway incursions and will
continue to advance these recommendations in the near and long term.  Our specific
replies to your draft report recommendations are listed below:

1) **Advance the low-cost technologies most likely to reduce runway incursions**
   **quickly to high-risk airports.**

FAA response: The FAA has completed an initial evaluation and demonstration of six
emerging, low-cost technologies, and recommended that three of the six be further
evaluated: Flashing Precision Approach Path Indicator (PAPI), Ground Marker
technologies, and Addressable Message Boards.  Thus far, we have demonstrated that
the mechanisms of the various technologies can work as envisioned.  However, these
three technologies are still in the research and development (R&D) phase, and need to
be further developed and evaluated.

Next, we would need to determine that the systems are cost beneficial and that there
is a cause and effect relationship between the individual technologies and the
reduction of runway incursions.  Finally, a larger operational evaluation would be
essential before any technology is integrated into the national airspace system (NAS).

The current status of the three technologies is as follows:

- Flashing PAPI lights
  The FAA completed a demonstration at Long Beach, CA, in September 2002, and
  is presently developing a strategy to transition the flashing PAPI technology into
  an acquisition program.  While we are encouraged about the system, success is
  dependent upon the development of a reliable and affordable sensor to enable
  NAS integration.  A sensor has not yet been identified, but we conducting an
  evaluation for a potential candidate.

- Ground Marker technologies
  The Ground Marker system design was modified to address technical issues
  identified during the initial demonstration.  A preliminary system design review
  was conducted in December 2002.  The FAA awarded a follow-on contract for
  Ground Marker system engineering, integration, and installation in February
  2003.  Performance of this contract will lead to a prototype Ground Marker
  system installation at one airport by September 2003.

- Addressable Message Boards

These message boards have completed the proof of concept phase, and further development is warranted. However, substantive issues regarding compatibility to the airport environment and system performance have been raised that we believe can be accommodated. Simulation to evaluate concerns is scheduled for September – December 2003.

Recognizing that the above technologies have protracted R&D timeframes, we are engaging in other projects with quicker turnaround potential to improve pilot situational awareness. Below are two examples:

- An analysis of paint enhancements in the hold line environment is planned for the Providence, RI airport with an initial evaluation scheduled in 2003. A joint industry-government work group has already completed simulation work, which validated the paint enhancements.

- Enhanced lighting will be evaluated at airfield intersections at the North Las Vegas, NV airport. Site preparation is scheduled in April 2003 with construction in September 2003.

2) **Expedite technologies, such as in-cockpit surface moving map displays, to aid pilots in reducing runway incursions.**

FAA response: On March 17, 2003, FAA published Advisory Circular (AC) 120-76A, *Guidelines for the Certification, Airworthiness, and Operational Approval of Electronic Flight Bag Computing Devices*. This guidance is key to providing a low-cost tool for the prevention of accidents on the airport surface, the availability of an electronic moving map.

To support the eventual integration of moving maps, the FAA has developed a digital map database, has published 40 airfield surface maps to date, and expects to complete 78 maps by December 2003. An additional 80 maps are planned for 2004. These maps can be used with Electronic Flight Bags, which display aviation data that was previously obtained from paper documents.

More work needs to be done to implement "ownership" position on the moving map, and to make the technology more affordable. The Commercial Aviation Safety Team (CAST), a joint industry and government team, is developing an implementation plan, but has not reached consensus on implementation largely due to the current projected financial burden on the industry.

3) **Provide the Runway Safety Program Director with authority to ensure that employees from other lines of business complete tasks to reduce runway incursions on time. An accountability mechanism, such as directing the Runway Safety Program Director to provide input on individuals' performance appraisals and bonuses, should be developed to hold people**

**involved with runway safety accountable for completing initiatives within established milestones.**

FAA response: The Administrator has directed that performance standards of the key senior executives agency-wide delineate accountability for runway incursion risk reduction. Specifically, the Associate Administrator for Air Traffic Services is accountable for the reduction of runway incursions and the related risk resulting from operational errors. The Associate Administrator for Regulation and Certification is accountable for the reduction of runway incursions and the related risk resulting from pilot deviations. The Associate Administrator for Airports is accountable for the reduction of runway incursions and the related risk resulting from vehicle and pedestrian deviations. The Associate Administrator of Research and Acquisitions is accountable for the development and implementation of runway safety technologies to reduce the risk of runway incursions to the traveling public.

Further, Category A and B runway incursions are an FAA GPRA sub-goal that receives attention and focus in DOT, government and industry. Within FAA, the GPRA Runway Incursion Performance Measure has been widely integrated into the senior executives' compensation package.

The Office of Runway Safety (ARI) continues to provide analysis and develop strategy to identify collision risk on the runway and influence its resolution. ARI reports quarterly to the Administrator with an evaluation of the lines of business (LOBs) progress on accomplishing their runway safety objectives to reduce runway incursions.

4) **Implement recommendations in its Runway Incursion Airport Assessment Report, published January 29, 2003, made as a result of technological reviews of the 13 problem airports identified in our 2001 report.**

FAA response: The FAA conducted assessments at 16 airports (including the 13 problem airports identified in the OIG's 2001 report), and categorized four primary areas: 1) lack of perimeter security, which results in unrestricted vehicle access to the airport movement area; 2) complex and confusing airport layouts; 3) inadequate surface markings and signs; and 4) opportunities for low-cost technology enhancements.

We are working at the field level to coordinate improvements to security, surface markings and signs. Of the six airports identified for improved surface markings/signs, four have been completed (Deer Valley Municipal Airport, AZ; Flying Cloud Airport, MN; Montgomery Field, CA; and North Las Vegas Airport, NV) and two are in progress (Denver Centennial Airport, CO; and Concord Buchanan Airport, CA). Analyses are underway at the Seattle-Tacoma Airport, WA and at the Atlanta-Hartsfield Airport, GA to understand factors impacting safety and efficiency relative to airport taxiway layout with the expected outcome of revised taxiway designs and procedural modifications. Another effort is planned for Concord

Buchanan Airport, CA that will focus on alternatives to simplify the configuration of this airport.  Our intent is to use this work to prototype improvements to surface operations in the NAS.  The strategy is to complete the prototype work in 2004 and begin to selectively work through the higher capacity commercial and general aviation airports in 2005.

5) **Conduct reviews at the 4 airports that had 10 or more runway incursions over the 4-year period 1999 to 2002 to determine whether technological solutions are needed.**

FAA response: This work has already been directed, and will be completed in 2003. We will conduct assessments at Denver/Jeffco, Colorado; Prescott, Arizona; Fresno, California; and Palm Beach, Florida airports to determine whether technological or non-technological solutions would be beneficial in reducing runway incursion risk. When the assessments are complete, a new report with the findings and actions will be produced.

**2) Take action in conjunction with NATCA, to rescind applicable provisions of the January 17, 2001 MOU and its April 27, 2001 addendum that revised the training requirements for operational errors and precluded managers from revoking or suspending controller Control Tower Operator licenses and Facility Ratings based on performance deficiencies.**

FAA Response: We are currently involved in a review of our existing MOUs. The provisions of this particular MOU will be re-examined as part of this process.

**3) Revise FAA Air Traffic Quality Assurance Order 7210.56C to:**
   **a. require that controllers who are involved in multiple errors receive training,**
   **b. require that controllers who have moderate and high rated operational errors receive training, and**
   **c. eliminate the provision that precludes managers from revoking or suspending controller Control Tower Operator licenses and Facility Ratings based on performance deficiencies**

FAA Response:

   a. Addressed under OIG recommendation 2.

   b. Addressed under OIG recommendation 2.

   c. Addressed under OIG recommendation 2.