RUNWAY SAFETY BLUEPRINT 2002-2004

JULY 2002

OFFICE OF RUNWAY SAFETY
FEDERAL AVIATION ADMINISTRATION

WWW.FAA.GOV/RUNWAYSAFETY

Message from the Administrator

Aviation has achieved a remarkable safety record. Within the National Airspace System, millions of operations are completed safely every year. This is tribute to the pilots, controllers, aircraft mechanics, airport personnel, and countless others who work with us every day to ensure the safety of our skies.

Despite the high-level proficiency of these aviation professionals, a small number of significant and persistent errors still occur.

One of my top priorities as Administrator has been the reduction of accidents and incidents caused by runway incursions.

The 2002-2004 Runway Safety Blueprint defines our strategy and prioritizes our efforts to reduce runway incursions. It presents the current state of runway safety at towered airports and identifies those areas where improvement is needed.

Although the Blueprint was prepared by the FAA and presents an FAA perspective, it acknowledges the critically important contributions of everyone working in the aviation industry. Runway safety can only be improved through the concerted effort of individuals and organizations throughout the agency and the industry. The pervasiveness of the causal factors means that everyone involved in aviation must participate in the search for solutions: we can only improve runway safety through the constructive collaboration of the entire aviation community.

I ask all of you to give the Blueprint your full support and commitment.

Jane F. Garvey
Administrator

The 2002-2004 Runway Safety Blueprint

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The 2002-2004 Runway Safety Blueprint

Executive Summary

Both the severity and the frequency of runway incursions were decreased in Calendar Year (CY) 2001 from CY 2000. However, it is far too soon to declare that a trend towards a systemic reduction is underway. The NAS continues to experience about one Category A or B runway incursion per week at towered airports, thereby making runway incursions a continuing threat to aviation safety. While work continues to identify why incursions happen and what steps can be taken to prevent them, there is enough fundamental information known to provide clear direction for planned interventions. Key points are:

- Operational performance in the airport movement area must be further improved to reduce runway incursions.
- Runway incursions are systemic, recurring events that are unintentional by-products of NAS operations.
- Operations must be standardized to reduce risk at a time when growth is challenging runway and infrastructure expansion.
- Collision-avoidance safeguards need to be developed for the high-energy segment of runways, where aircraft are accelerating for take-off or decelerating after landing.
- Human factors is the common denominator in every runway incursion.

On the basis of data analyses carried out by the FAA and its partners in the aviation community, a core strategy has been developed for improving runway safety. It is structured around eight long-term goals and a set of supporting objectives.

The first edition of the Runway Safety Blueprint, published in 2000, presented FAA's corporate approach to reducing runway incursions. This second edition, Blueprint 2002-2004, updates the earlier document based on the results of data collection and analyses carried out during the past year, presents an overview of the accomplishments in Fiscal Year (FY) 2001, and defines the objectives to be achieved in 2002-2004. It summarizes the nearly 50 activities carried out during the past year that relate to our overarching goals and supporting objectives.

Through the Safer Skies Initiative, several safety goals and issues have resulted from the work of the Runway Incursion Joint Safety Implementation Team (RI JSIT). The RI JSIT is a collaboration of the Commercial Aviation Safety Team (CAST) and the General Aviation Joint Steering Committee (GA JSC). The final report of the RI JSIT identifies 11 enhancements with detailed implementation plans that have been incorporated into the objectives of Blueprint 2002-2004. The RI-JSIT report, which is provided in Appendix A, will continue to be a source for ensuring that the industry/government data-driven, consensus based process provides a substantial input to the systematic mitigation of runway incursion risk.

The diversity of organizations and aviation professionals participating in various aspects of the runway incursion program clearly demonstrates the pervasiveness and complexity of the problem. It also underscores the necessity for broad collaboration throughout the aviation community if success is to be achieved.

The 2002-2004 Runway Safety Blueprint

I. Introduction

The purpose of Blueprint 2002-2004 is to: (1) define and prioritize many of the coordinated efforts between the FAA and the aviation community to reduce runway incursions, and (2) to create engagement and alignment between FAA headquarters/regional staffs and the aviation community, which is essential to achieve success. Blueprint 2002-2004 is an FAA document that has been developed in consultation with the CAST and supports government and industry efforts to improve runway safety. It presents the current state of runway safety at towered airports in the NAS, and identifies those areas where progress needs to occur.

A runway incursion is defined as "any occurrence in the airport runway environment involving an aircraft, vehicle, person, or object on the ground that creates a collision hazard or results in a loss of required separation with an aircraft taking off, intending to takeoff, landing, or intending to land." The National Transportation Safety Board (NTSB) considers the reduction of runway incursions to be one of its most wanted transportation safety improvements. The Department of Transportation (DOT) Office of Inspector General has identified runway incursions as one of the most difficult management challenges facing the DOT. Runway safety remains a top FAA safety priority.

Runway safety can only be improved through the concerted effort of individuals and organizations throughout the agency and industry. This document reflects many of the activities initiated by airport managers, airline operations, maintenance, safety personnel, pilots, air traffic controllers, industry associations, labor organizations and others. While this document originated in the FAA and presents an FAA perspective, it acknowledges the critically important contributions of everyone working in the aviation industry, especially pilots, controllers, aircraft mechanics, and airport vehicle drivers.

Key Points

Recognition of the following key points is fundamental to formulating and implementing solutions to improve runway safety for the nation:

1. Operational performance in the airport movement area must be further improved to reduce runway incursions. The NAS involves enormously complex interactions among air traffic controllers in the tower and people who operate on the airport surface, including pilots, mechanics, maintenance technicians, and airport employees. Improved awareness efforts and compliance are required to reduce runway incursions. A frequent reason runway incursions occur is loss of situational awareness. The major breakdowns in operational performance that result in runway incursions at towered airports are:

   Pilots who:
   a) enter a runway or cross the hold short line after acknowledging hold short instructions,
   b) take off without a clearance after acknowledging "taxi into position and hold" instructions.

Air traffic controllers who:
a) lose required arrival/departure separation on the same or intersecting runways,
b) make runway crossing separation errors.

Vehicles drivers and pedestrians who:
a) cross a runway without any communication or authorization,
b) enter a runway after acknowledging "hold short" instructions.

2. Runway incursions are systemic, recurring events that are unintentional by-products of NAS operations. Runway incursions are systemic because they are related to existing aviation procedures, airport geometry, training, operations, communications, and NAS infrastructure components. Improvements to the NAS will be required to reduce risk and improve safety performance.

3. Operations must be standardized to reduce risk at a time when growth is challenging runway and infrastructure expansion. Aviation in the United States is a mass transportation system with thousands of unique components. There are more than 480 towered airports (and thousands of non-towered airports), over 15,000 air traffic controllers, in excess of 650,000 pilots, and greater than 240,000 aircraft, all conducting millions of operations around the clock. Improvements that standardize operations and reduce risk on the airport surface will be essential to foster improved performance and safe growth.

4. Collision-avoidance safeguards need to be developed for the high-energy segment of runways. Fatalities are most likely to occur in the first two-thirds of the runway (typically called the high-energy segment) where aircraft are accelerating for takeoff or decelerating after landing. Approximately 65 million takeoffs and landings, plus millions of crossings, occur annually in this segment of the runway. Improvements to airport geometry, airport and aircraft technology, operating procedures, and airport usage patterns that address incursion risk on this runway segment will be required to reduce collision risk in the future.

5. Human factors is the common denominator in every runway incursion. A systematic attack on this aspect of the problem will require detailed analyses of the causes of these errors and the design of approaches to mitigate them.

These five conclusions, drawn from the ongoing analyses of runway incursion reports, will direct our systematic search for solutions. Given the constraints of time and resources, however, it is necessary to assign priorities. The guidance is to first invest our assets to resolve the problem of collision avoidance on the high-energy areas of runways – potentially the most lethal of the risks.

The 2002-2004 Runway Safety Blueprint

Runway Safety Strategy

Achieving a significant reduction in the severity and frequency of runway incursions requires a strategy encompassing a vision, a mission, and a set of goals and objectives that provide guideposts and milestones. This document lays out a strategy undertaken by the Office of Runway Safety that is directly tied to the Department of Transportation (DOT) and FAA missions.

DOT Mission

Serve the United States by ensuring a safe transportation system that furthers our vital national interests and enhances the quality of life of the American people.

FAA Mission

FAA provides a safe, secure, and efficient global aerospace system that contributes to national security and the promotion of United States aerospace safety.

The vision of the Office of Runway Safety is to *set the world's standard for runway safety*.

Our mission, in order to achieve that vision, is *to increase the safety of the flying public by reducing the severity and frequency of runway incursions through coordinated efforts with the aviation community*. Our desired outcome is *zero fatalities resulting from runway incursions*.

By reducing severity, incursions will more likely be minor rule infractions instead of near-collisions. The emphasis will be to complete actions that reduce the opportunity for collision risk in the high-energy segment of the runway. Activities include revisions to procedures, changes to airport geometry, and installation of technology or infrastructure that will help to eliminate the opportunity for human error and collisions in the high-energy segment.

By reducing frequency, incursions of any type will become extremely rare occurrences. Corrective actions will aim to reduce the potential for human error through training, technological aids, or infrastructure improvements that enhance situational awareness.

In support of our mission, we have defined eight goals that form the basis for the Runway Safety Program. These goals stem primarily from the thrusts defined in Blueprint 2000. The measure of our progress will be a continuous reduction in the number of Category A and B runway incursions.

The 2002-2004 Runway Safety Blueprint

Runway Safety Program Goals

1. Develop and distribute runway safety education and training materials to controllers, pilots and all other airport users.
2. Increase surface safety awareness throughout the aviation community.
3. Assess and modify procedures to enhance runway safety.
4. Improve runway safety data collection, analysis, and dissemination.
5. Identify and implement enhancements to improve surface communications.
6. Increase situational awareness on the airport surface.
7. Support and deploy new technologies that reduce the potential for collision.
8. Implement site-specific runway safety solutions in coordination with local aviation communities.

II. Description of Runway Safety Performance

CY 2000 and CY 2001 Runway Safety Performance

In CY 2000, over 67 million tower operations (takeoffs or landings) were conducted in the NAS. Contained within these millions of takeoffs and landings were 431 reported runway incursions. The rate of runway incursions per one million towered airport operations was 6.4; both numbers represent a significant increase from the CY 1999 figures (see Figure 1). When the 431 CY 2000 runway incursions were evaluated on a case by case basis, 67 of the 431 incursions were considered serious enough to pose a significant risk of collision, also known as Category A or B incursions (see Figure 2). Accordingly, the risk of a Category A or B runway incursion in the system was approximately one in a million. In March 2000, one collision occurred involving two general aviation aircraft with four fatalities.

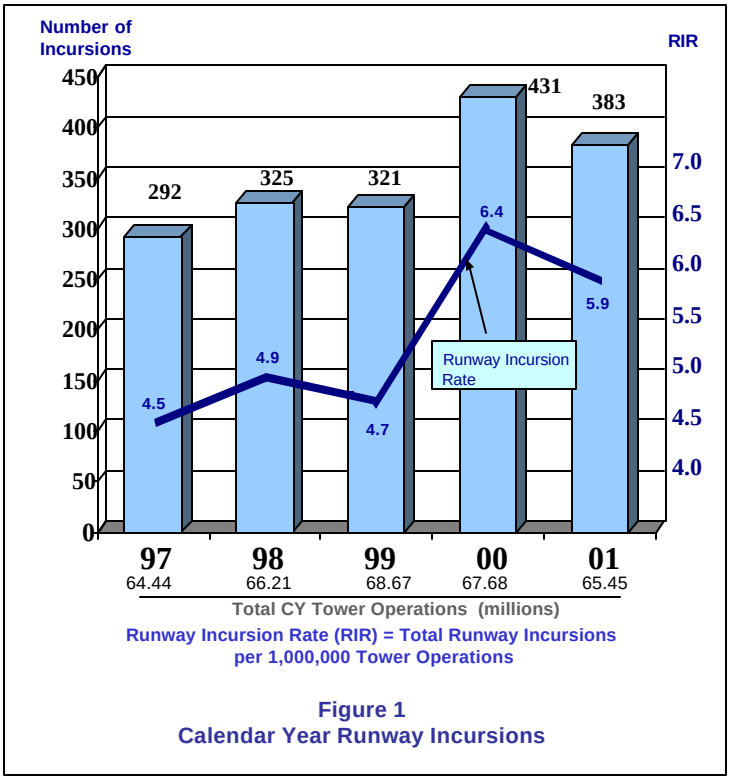

Figure 1
Calendar Year Runway Incursions

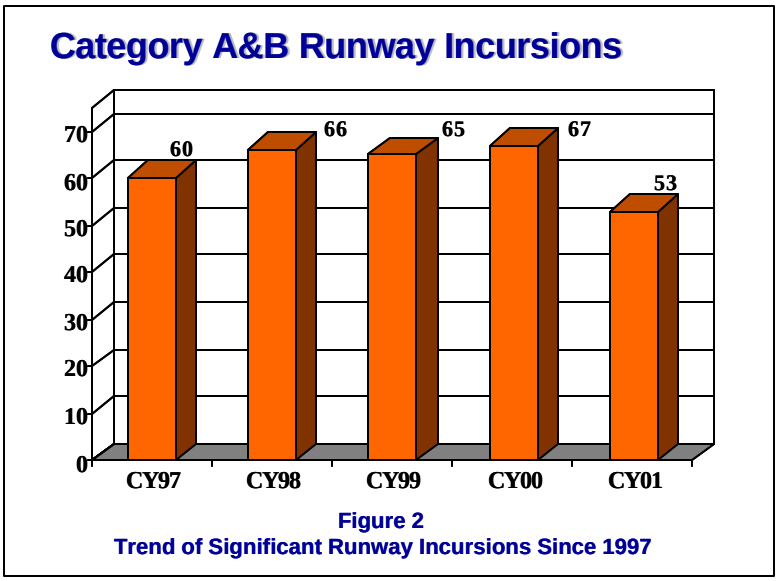

Figure 2
Trend of Significant Runway Incursions Since 1997

When CY 2000 results were viewed on a weekly basis, there was more than one Category A or B runway incursion per week (67 over the year) at towered airports somewhere in the NAS. As the 67 Category A and B events were further analyzed, another troublesome picture emerged. About once a month, on average, a jet transport aircraft came into close proximity with another jet transport at high speed at a towered airport.

During CY 2001, over 65 million tower operations were conducted, which is a 3.3% reduction from CY 2000. Progress was made in reducing runway incursions. There was a decrease in the total number of runway incursions (see Figure 1), and the rate of runway incursions per one million operations was 5.9. More importantly, the number of the Category A and B runway incursions decreased compared to CY 1997-2000 (see Figure 2). CY 2001 Category A and B incursions were also reduced when compared to the four-year average from CY 1997 to CY 2000. Figure 3 shows that 19 percent of all runway incursions were in Category A or B during CY 1997–2000, but the corresponding number was reduced to 14 percent in CY 2001. While both reductions reflect improvement and movement in the right direction, it is far too soon to declare that the reductions are evidence of a systematic trend. The NAS still averaged about one Category A or B runway incursion per week (64.5 for 1997-2000 yearly average vs. 53 for CY 2001), but less than one (0.58) close call jet transport-to-jet transport runway incursion per month in CY 2001.

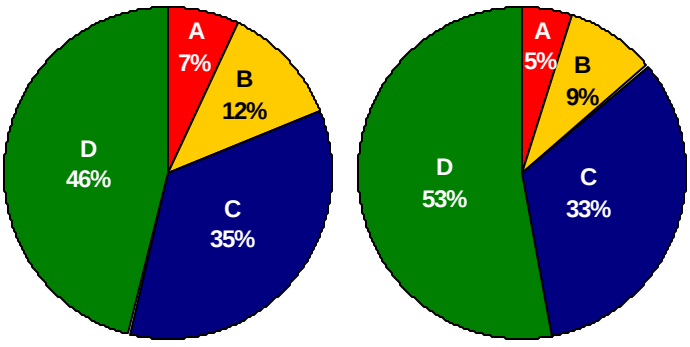

Figure 3
Comparison of Runway Incursion Severity Distribution

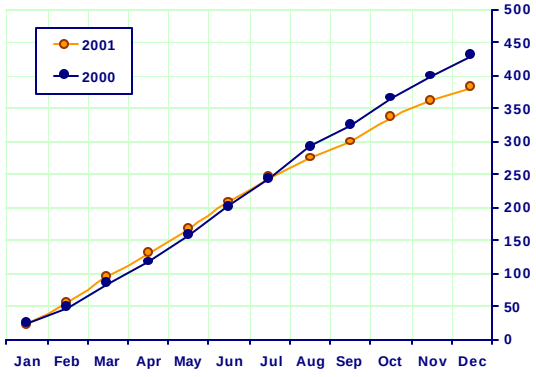

Figure 4
Runway Incursion Comparison CY2000 to CY2001

As shown in Figure 4, runway incursions were reduced starting in May 2001 (compared to CY 2000) and continued throughout the year. Credit for the reduction is most likely due to the extensive awareness and educational activities begun in CY 2000 and from the reduction in operations from the September 11 terrorist attacks.

Terrorist attacks during CY 2001 reduced towered airport operations and logically reduced runway incursions to some degree. However, analyses reveal that both the severity and frequency of runway incursions were reduced over CY 2000, with reductions beginning prior to September.

Runway Safety Analyses

Analysis of runway safety data has been a continuous activity. The purpose of these analyses was to increase knowledge concerning incursion trends, to better understand causal factors, and to identify where risk of collision is the greatest. Brief conclusions from these analyses are presented below. Additional detail on incursion trends can be found at the Office of Runway Safety web site, http://www.faa.gov/runway safety.

FAA Runway Safety Report 1997-2000

The FAA Runway Safety Report, completed in June 2001, was an extensive effort to better understand the risk posed by runway incursions. Four years of runway incursions (1,359 events) were individually assessed and assigned one of four severity categories. The results range from Category A to Category D (see Appendix B for a detailed description of the category definitions). Figure 5 graphically displays the findings. There were three runway collisions during the study that were included as Category A events.

The red and yellow lines, i.e., Categories A and B, indicate very stable numbers over the four years. These represent the steady state (systemic) risk level for near-collision runway incursions in the NAS. The blue and green lines illustrate significant increases of Categories C and D incursions. Since volume is fairly stable during the period, this increase is assumed (but not proven) to be due to an increased emphasis on full reporting of runway incursions.

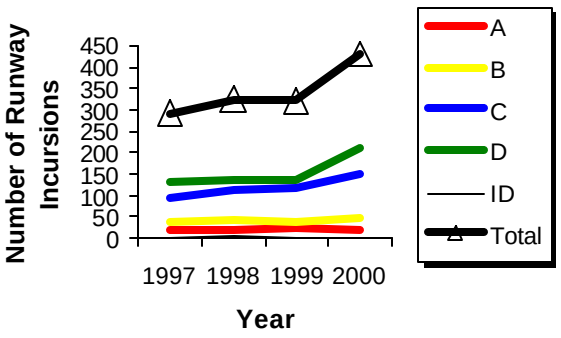

Figure 5
Annual Number of Reported
Runway Incursions by Severity 1997-2000

FAA Runway Safety Report 1998-2001

The second runway safety report, "FAA Runway Safety Report, CY 1998 – CY 2001," was released in July 2002. This report presented additional analyses of runway incursion trends at United States towered airports and includes 2001 data. Figure 6 shows the annual number of runway incursions for the 1998-2001 timeframe. Findings in this report validate the conclusions of the previous report.

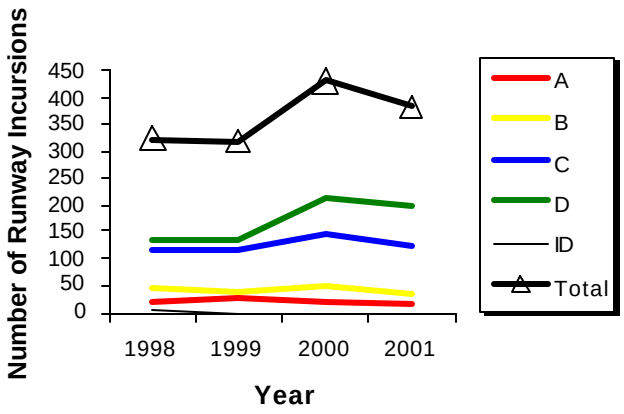

Figure 6
Annual Number of Reported
Runway Incursions by Severity 1998 –2001

The two reports support the conclusion that runway incursions are systemic, recurring, and potentially catastrophic events. Another finding was that total operations at an airport is not an accurate predictor of runway incursions. This finding leads one to conclude that airport geometry, local conditions, and aircraft mix have a strong influence on runway incursions, and that standardization, where practicable, will improve performance. The reports are available at the Office of Runway Safety web site, **www.faa.gov/runwaysafety**.

Human Error and Causal Factor Analysis

Experience has shown that the opportunities for human error are abundant. The proximity and number of aircraft in the airport environment, combined with the complexity of operations and the requirement for precise timing, conspire to make the airport movement area surface unforgiving of errors by pilots, air traffic controllers, vehicle drivers, and pedestrians.

Several independent analyses have recommended revisions in the process by which operational errors and pilot deviations are recorded if risk assessments of airport operations are to be more rigorous. While the information recorded for an operational error is extensive, there are critical operational variables that are not systematically recorded (such as the number of operations per runway). The information recorded on the pilot deviation form lacks the level of detail of the operational error report.

Despite this, however, analysis of existing information conducted by the MITRE Center for Advanced Aviation System Development, the RI JSAT, and the Volpe National Transportation Systems Center has determined some of the causal factors of runway incursions. The overwhelming category of both pilot and controller errors can be classified as a loss of "situational awareness." Specifically, when tower controllers are involved in an operational error, it is typically due to one or more of the following:

- Forgetting about an aircraft, a closed runway, a vehicle on the runway, or a clearance that the controller issued,
- Miscalculation of the impending separation,
- Communication error – hear-back errors (i.e., failing to catch a read-back error),
- Misidentifying an aircraft or its location (and issuing an instruction to the "wrong" aircraft), and
- Incomplete or inadequate coordination among controllers.

Runway incursions caused by pilot deviations also result from a lack of situational awareness. The most common pilot deviations on the airport surface result from failing to "hold short" as instructed. In some cases, this is attributable to a miscommunication or misunderstanding of the clearance (i.e., the pilot thinks he/she is cleared to cross or hold in position on the runway). In other cases, the pilot is disoriented (i.e., thinks he/she is one place when they are actually in another) or did not "see" the hold short lines.

The analyses conducted to date have been informative, but incomplete. More detailed analyses of data from sources that were not previously available are planned to gain a more comprehensive understanding of the causes and remedies of runway incursions.

Runway Incursion Location Data Review

The role of location was analyzed by examining reports of where incursions occurred at airports during CY 2000 and 2001.

By viewing incursion data in this manner, it is apparent that the vast majority of Category A and B runway incursions occur in the first two-thirds, or high-energy area, of the runway. As shown in Figure 7, the seven collisions at towered airports over the last 11 years occurred in the high-energy portion of the runway. The conclusion drawn from this analysis is that if runway safety risk is to be reduced in the future, the opportunity for collision needs to be effectively and permanently reduced in the high-energy segment of the runway.

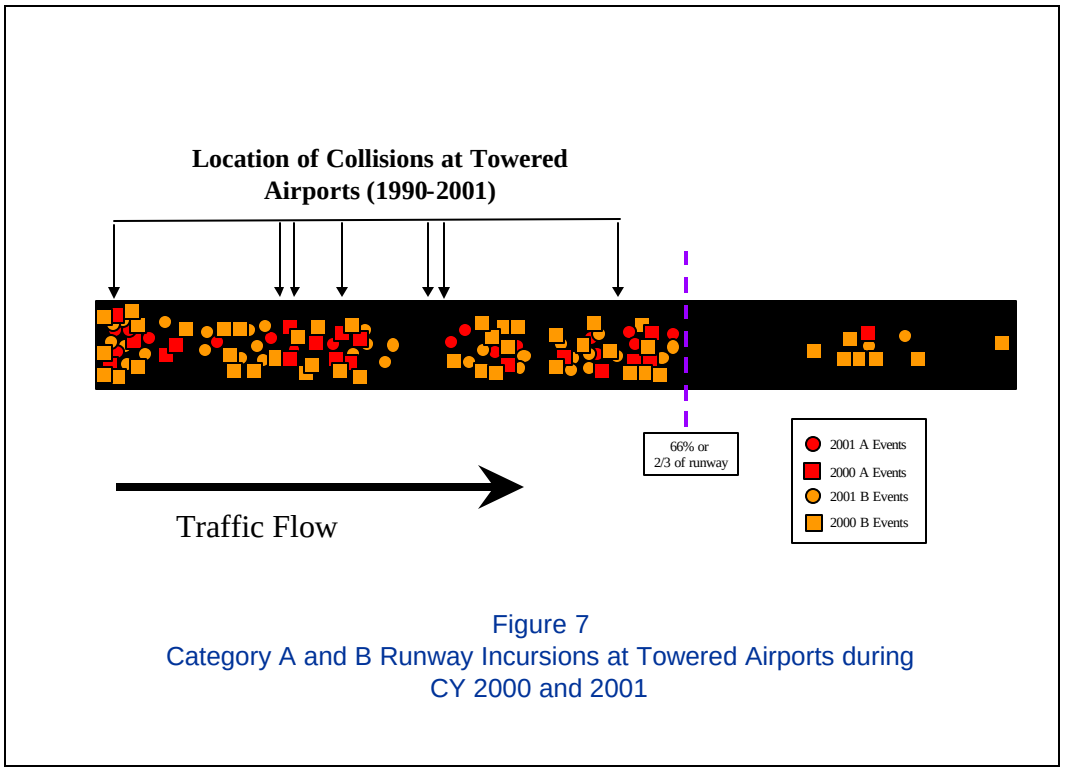

Figure 7
Category A and B Runway Incursions at Towered Airports during CY 2000 and 2001

Note: Until 2001, the FAA Office of Runway Safety had been reporting runway incursion statistics on a calendar year basis. However, the Government Performance and Results Act (GPRA) requires that performance measures be reported on a fiscal year basis. Therefore, the Office of Runway Safety will begin reporting runway incursions on a fiscal year basis beginning with FY 2003.

III. Accomplishments to Date

Planning for FY 2001 was aggressive. Runway incursions were on the increase, but there was not enough information to fully understand the reasons. The strategy, therefore, was to accomplish as many promising initiatives as possible across the seven emphasis areas identified in the first Blueprint. This approach has yielded mixed results. Runway incursion awareness was certainly raised and reporting made a priority.

During 2000, the Office of Runway Safety made a concerted effort to identify wide-ranging ideas useful in reducing runway incursions. Nearly 1,000 recommendations were collected. From these recommendations, and in cooperation with the RI JSAT, ten near-term initiatives were selected. These ten initiatives stem from the Runway Safety Summit held in June 2000. Of these ten, seven have been completed. The remaining three are nearing completion and are addressed in Section IV, Objectives 1.6, 1.9, and 5.1. An additional 76 "roll-up" initiatives were also identified. FAA Lines of Business (LOB) reviews produced a final set of activities that identified schedule and budget information. Both the near-term and roll-up initiatives were included in the FY 2000 Blueprint and integrated as appropriate into Blueprint 2002-2004 to meet changing demands.

Equally important are the substantial runway safety efforts accomplished by other organizations throughout the aviation community, especially those of the RI JSIT listed in Appendix A. The activities of these organizations range from distribution of runway safety materials, to articles in trade and aviation publications, and safety seminars. Increased emphasis from the nation's flight instructors during initial and recurrent training is an invaluable contribution to our goal of safer runways. Easy access to airport diagrams on web sites (e.g., www.faa.gov/runwaysafety) encourages a higher level of pre-taxi preparations. These safety efforts are critical to the improvement of runway safety.

Recent accomplishments are presented below.

Runway Safety Program

- Conducted education, training and awareness for pilots, controllers/vehicle operators – more than 250,000 pieces of program materials were distributed.
- Established a regional runway safety position in all nine regions including support staff.
- Performed runway incursion risk determination and analysis – runway incursions from 1997 through 2001 were assessed and assigned a severity category.
- Revised and improved the Runway Safety Action Team (RSAT) process.
- Conducted a second human factors symposium.
- Conducted an independent management review of runway safety program initiatives.
- Improved and enhanced the Runway Safety Program web site – more than 1.4 million hits were recorded that represent over 91,000 unique visits.
- Published the first Runway Safety Report (1997-2000).
- Published the second Runway Safety Report (1998-2001).

- Continued participation in the CAST and RI JSIT process.
- Established a runway safety objectives database.
- Established a Runway Safety Action Team database.
- Developed data base linkages to enhance information analyses and distribution.
- Developed and distributed an airport vehicle operator training videotape

Regional Runway Safety Programs

- Conducted 102 Airport Runway Safety Action Team (RSAT) site visits.
- Conducted a second round of Regional Runway Safety Workshops – twelve workshops were conducted in 2001/2002 and the remainder will be accomplished in 2003.
- Distributed regional runway safety information.
- Conducted regional runway safety pilot seminars.
- Developed and distributed training programs on CD-ROM.
- Established cross-organization program coordination at the regional level.
- Conducted runway safety data collection and analyses.

Air Traffic

- Enhanced operational tower controller training.
- Identified memory enhancement techniques training for tower controllers.
- Conducted pilot/controller communications phraseology reviews.
- Conducted Air Traffic Teamwork Enhancement (ATTE) Training for Tower Controllers.

Flight Standards

- Conducted foreign air carrier pilot training, education and awareness.
- Published and distributed Advisory Circulars (AC) 91-73 and 120-74 for airport surface operations.
- Improved pilot evaluation and testing.
- Developed Runway Incursion Prevention Training for Aircraft Mechanics – videotape produced in English and Spanish.
- Conducted runway incursion prevention seminars for pilots and aircraft mechanics – conducted 1,467 safety meetings with a total attendance of 104,160.
- Reviewed Title 14 CFR for runway incursion training adequacy.
- Revised pilot written exams and practical test standards.

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Airports

- Established revised airport markings for hold short lines.
- Developed a vehicle operations Advisory Circular – coordinated development with industry.
- Enhanced training for airport inspectors centered on runway incursion prevention.
- Conducted a review of airport signs, markings and lighting standards.
- Co-initiated a review of airport paint markings and airport design issues.

System Safety

- Conducted runway incursion callbacks through the NASA Aviation Safety Reporting System (ASRS) Program.
- Established runway severity categories.

Technology

- Published a broad agency announcement and selected seven promising technologies for evaluation.
- Under the Safe Flight 21 Program, awarded avionics development and demonstration contracts that included surface moving map capability.
- Conducted Safe Flight 21, Operational Evaluation II in Louisville, Kentucky, to demonstrate safety surface applications
- Held a modernization day demonstration in Memphis, Tennessee, to collect data on surface safety and efficiency applications.
- Performed first operational Airport Movement Area Safety System (AMASS) installation. AMASS systems are now operational in 50 percent of planned locations.
- Awarded Airport Surface Detection Equipment – Model X (ASDE-X) contract – program on schedule.
- Conducted airport technology needs assessments – seven of fourteen airport assessments completed as of the end of June 2002.

Airway Facilities

- Performed ongoing airspace system inspection pilots surveillance of surface movement operations area.

Human Factors

- Published human factors and runway safety booklet “Runway Safety: It’s Everybody’s Business.”
- Convened second symposium on human factors and runway incursions.

IV. Goals and Objectives

The actions to be undertaken in FY 2002-2004 are based on goals and associated objectives that are aimed at reducing risk and improving safety at the nation's towered airports. Runway incursions are often the result of multiple errors that can lead to high consequence mishaps. No single remedy to the problem exists. Improvements to procedures, infrastructure, airport geometry and individual performance are necessary to create multiple layers of defense and permanently reduce runway incursions to an insignificant level.

Improvements in the performance of pilots, controllers and airport vehicle operators are essential if the severity and frequency of runway incursions are to be reduced. Because NAS operations are complex and constantly evolving, pinpoint prediction of the next incursion or collision is not possible. System-wide performance improvement on the airport surface is required to reduce runway incursion risk. A strategy providing layered approaches to safety and human-error prevention is required to achieve zero fatalities on the nation's runways.

Eight goals have been established for the improvement of airport surface safety:

1. Develop and distribute runway safety education and training materials to controllers, pilots and all other airport users.
2. Increase surface safety awareness throughout the aviation community.
3. Assess and modify procedures to enhance runway safety.
4. Improve runway safety data collection, analysis, and dissemination.
5. Identify and implement enhancements to improve surface communications.
6. Increase situational awareness on the airport surface.
7. Support and deploy new technologies that reduce the potential for collision.
8. Implement site-specific runway safety solutions in coordination with local aviation communities.

The goals are based on the seven thrusts identified in the October 2000 Blueprint. Thirty-nine objectives have been defined to support achievement of these goals. A lead organization and one or more partnering organizations have been assigned for each objective. Success requires that these objectives be accomplished across FAA lines of business, governmental organizations, industry, and commercial and general aviation.

The FAA's Runway Safety Program works in partnership with the Safer Skies RI JSIT in accomplishing its mission. Blueprint 2002 includes objectives, defined by RI JSIT, to address enhancement of standard operating procedures, ATC training and procedures, pilot training, implementation of enhanced visual aids, and implementation of technology to increase situational awareness (see Appendix A).

Effective runway safety activities will be led and implemented by the relevant FAA lines of business. The Regional Runway Safety Program managers and their staffs will participate in activities at the regional and local levels and will provide local coordination of runway safety activities.

Participating organizations that may support the lead organization in accomplishing each objective are listed in this document. These lists are representative and it should be understood that other organizations may become involved, as required.

A brief (one-page) implementation plan for each objective, describing the major tasks, milestone dates, and required resources will be prepared by the lead organization and used for periodic assessment of progress. The Office of Runway Safety will provide support and status tracking for each of the objectives.

The objectives and participating organizations are outlined below:

Goal 1. Develop and distribute runway safety education and training materials to controllers, pilots and all other airport users.

Ten objectives were defined under the education and training goal:

Objective 1.1 – Develop new training courses or information briefings for Air Traffic Controllers that address the issue of reducing operational errors that lead to runway incursions.

Currently, there are limited runway safety training materials for air traffic controllers. Effectiveness of training – in particular recurrent and refresher training – is significantly reduced when materials are viewed repeatedly. Utilization of actual events as a basis for creating relevant training materials is possible with existing technology. These courses may range from "trigger tapes" (based on actual events) that generate discussion to computer- or classroom-based training.

The lead organization for objective 1.1 is Air Traffic, with participation from labor organizations.

Objective 1.2 – Facilitate implementation and use of surface operations training at a minimum of ten air carriers based on the Single and Dual-Piloted Aircraft Surface Operations Advisory Circulars (91-73 and 120-74) at TITLE 14 CFR Part 121, 135, 141, and 142 organizations.

There were no established pilot surface operations training procedures at the time current training courses were developed. Many training organizations meet minimum requirements to prepare pilots for examinations based on Practical Test Standards, but do not cover surface procedures in depth. Now that AC120-74 and AC91-73 are available, training courses should be revised to incorporate this information.

The lead organization is Flight Standards. Participating organizations include airlines, cargo and air taxi operators, flight training and labor organizations, and industry associations.

Objective 1.3 – Distribute the mechanic runway safety taxi training CD-ROM to the major airlines.

Several high-profile incursions have involved mechanics repositioning aircraft on the airport surface. Mechanics do not typically receive formal training related to communications and surface navigation (i.e., airfield lights, signs and markings).

The lead organization is Flight Standards. Participating organizations include airlines, labor organizations, airports, and associations.

Objective 1.4 – Complete over 1,000 safety seminars per year incorporating runway safety, RIIEP, surface movement Advisory Circulars and marking, signage and lighting as seminar themes.

The Flight Standards organization conducts thousands of safety seminars throughout the country. Surface safety must be a significant and integral part of these seminars.

Flight Standards is the lead organization. The participating organizations include Airports and Air Traffic.

Objective 1.5 – Publish the airport vehicle surface operations Advisory Circular including best practices and SOP's. Coordinate with airport operators and associations to develop and ensure a successful implementation strategy and implementation plan.

There are no established guidelines or procedures available for airport vehicle operators. Currently, each airport develops their own guidelines that are used for training and licensing. Not all airports have the resources to develop a comprehensive set of procedures, best practices, SOP's, and standardization is needed. The American Association of Airport Executives (AAAE) has offered to lead an industry effort to develop an airport vehicle driver advisory circular.

The lead organization is Airports. Participating organizations include industry associations.

Objective 1.6 – Conduct research on surface operations memory aids, techniques, tools and training regarding memory limitations. Review existing course material to ensure that course curricula emphasize scanning techniques, anticipated separation and prioritization of control actions.

Existing controller training related to memory requires improvement. Based on data analysis, loss of situational awareness is the significant factor leading to operational errors resulting in runway incursions.

The lead organization for this objective is Air Traffic. Participants include the labor organizations.

Objective 1.7 – Require all tower controllers to complete approved training that emphasizes team effectiveness and situational awareness in an operational environment.

In most cases, control tower functions are conducted by a team of controllers. Experience has shown that people do not always work as effectively as possible in a team environment. Airlines have used Crew Resource Management training since the 1980's to enhance communication and coordination activities in cockpits; the same need exists in the ATC tower cab.

The lead organization for this objective is Air Traffic. Participants include the labor organizations.

Objective 1.8 –Develop course material and conduct training for initial and recurrent FAA Flight Standards Aviation Safety Inspectors (ASI) training. enhance awareness of Certified Flight Instructors (CFI) and designated pilot examiners (DPE).

Increased emphasis has been placed on pilot surface operations. Practical test standards and pilot certificate written tests have been revised to include more questions regarding the taxi phase of flight. Two advisory circulars have been published related to surface operational procedures and best practices. To ensure that safety inspectors are properly prepared, all inspectors need to go through training. CFI's and DPE's need to be fully appraised of changes to practical test standards.

The lead organization is Flight Standards:

Objective 1.9 – Develop and implement enhanced tower controller training.

Existing tower controller training provides basic information on surface operations, but does not include detailed operational specifics. A controller training workgroup was formed in response to the ten near-term initiatives identified in the first Blueprint. This workgroup addressed four areas that required training enhancements. The areas are separation minima, land and hold short operations (LAHSO), runway use, and airport lighting.

The lead organization for this objective is Air Traffic. Participants include labor organizations.

Objective 1.10 – Implement a program for foreign air carrier pilot training.

This objective calls for the development of a strategic plan that encompasses international aviation organizations, industry, and groups to address education, training, and awareness of U.S. airport surface operations for foreign air carrier pilots.

The lead organization is Flight Standards. Participants include association representatives.

Goal 2. Increase surface safety awareness throughout the aviation community.

Four objectives under the goal of enhanced surface safety awareness have been defined.

Objective 2.1 – Expand the role of Flight Service Station Specialists to provide runway safety information for towered and non-towered airports.

Providing timely information regarding surface safety to general aviation pilots is difficult due to the fact that there is no centralized dispatch providing flight-planning services similar to that used by company commercial pilots. However, many pilots utilize Flight Service Station resources for weather briefings, Notice to Airmen (NOTAM) information and for filing flight plans. Flight Service Station Specialists should create a centralized capability to stress runway safety awareness while briefing pilots.

The lead organization for this objective is Air Traffic. Participating organizations include Flight Standards and associations.

Objective 2.2 - Publish a series of letters (two to four) to all pilots discussing runway safety.

There are in excess of 600,000 licensed pilots in the U.S. Providing surface safety materials directly to pilots has increased awareness in the pilot community, but to date, all efforts have been to limited pilot groups. The initial mailing was a letter to all pilots and included the two surface operations advisory circulars, AC 120-74 and AC 91-73.

The lead organization for this objective is Flight Standards.

Objective 2.3 – Provide airport diagrams for towered airports via a link or other means as part of the standard Direct User Access Terminal Service (DUATS) to pilots.

Consistent use of airport diagrams by all pilots should improve situational awareness on the airport surface and reduce potential for runway incursions.

The lead organization is Air Traffic. Organizations participating in this objective include Flight Standards, Airports, and associations.

Objective 2.4 – Increase runway safety awareness within the aviation community by conducting at least one media emphasis project a year with trade and/or association periodical(s).

FAA Office of Runway Safety, in coordination with FAA Public Affairs, will meet with aviation trade media and/or association media at least once a year to discuss runway safety objectives and activities. Communications with target audiences, such as pilots, airport managers, and air traffic controllers, through feature coverage and story placements is key to generating interest in and raising awareness of runway safety.

The lead organization for this objective is the Office of Runway Safety. Participating organizations include the FAA Office of Public Affairs, appropriate FAA lines of business, associations, and labor organizations.

Goal 3. Assess and modify procedures to enhance runway safety.

The six objectives under this goal focus on procedures used in air traffic, pilot, and surface operations.

Objective 3.1 – Assess selected Air Traffic procedures in terms of enhanced runway safety and recommend actions to retain, modify, or eliminate as appropriate.

Certain existing air traffic procedures, while providing operational flexibility, may increase risk of a runway incursion but not enough information is known to make an accurate determination. Initial efforts will focus on the three procedures listed below. The purpose for the assessments will be to determine under what conditions these procedures contribute to incursions, to identify possible alternatives to use instead of these procedures (including modified application or

elimination), and to identify impact (safety, capacity, and workload) of alternative implementation.

Procedures to be assessed are TITLE 14 CFR Part 91.129(i) Taxi-to clearance, Use of Multiple Landing Clearances, and FAA Order 7110.65 paragraph 3-9-4, Taxi into position and hold.

The lead organization for this objective is the Office of Runway Safety. Participating organizations include Air Traffic, labor organizations, Flight Standards, System Safety, and NASA.

Objective 3.2 – Implement national standardized requirements for tower positions to ensure uniform, effective, and sustained situational awareness practices relating to surface operations.

More than a third of the most serious runway incursions have been attributed to controller operational errors. These errors stem from items including memory lapses, a lack of controller teamwork, improper scanning, poor prioritization of duties, and ineffective on-the-job training being conducted. These errors could be mitigated with training and procedural interventions.

The lead organization for this objective is Air Traffic. Participants include labor organization representatives.

Objective 3.3 – Implement standardization of national equipment and procedures for Runway Incursion Devices (RID).

There are several regions that have mandated the use of Runway Incursion Devices (RID), but there are no national standards for these procedures and devices. Air Traffic, in conjunction with the Office of Runway Safety, has developed a workgroup to address and resolve this issue.

The lead organization for this objective is Air Traffic. Participants include the labor organizations and Airway Facilities.

Objective 3.4 – Publish the best practices/SOP appendix to each of the two pilot Surface Movement Advisory Circulars (AC 120-74 and 91-73) and widely disseminate to the General Aviation Air Carrier communities.

Two surface operations advisory circulars were developed and published during FY 2001. AC120-74 was developed for dual-piloted aircraft and AC91-73 was developed for single-piloted operations. As a product improvement, best practices/SOPs are to be developed and included as appendices to the advisory circulars. Improvements to include SOP's and templates for use as examples in training materials, etc.

The lead organization is Flight Standards. Participating organizations include associations, designated pilot examiners, and fixed based operators (FBO) – flight training schools.

Objective 3.5 – During enroute inspections, Aviation Safety Inspectors ensure that pilots have current surface movement charts available and that they are in use.

Studies of previous runway incursions show that lack of surface situational awareness greatly increases the opportunity for incursions. Familiarity with and use of airport diagrams improves

surface situational awareness. The majority of towered airports have airport diagrams published in the instrument approach procedures and airport/facility directory publications.

The lead organization is Flight Standards. Participating organizations include airlines, cargo and air taxi operators, flight training and labor organizations, and associations.

Objective 3.6 – Develop advisory circulars that address procedures, best practices, and SOPs for airline maintenance taxi operators and for tug and tow vehicles while operating on the airport surface. Include "best practices" and a checklist. Coordinate with industry (airport managers, airlines, and Fixed Base Operators (FBO)) to use this information in training courses.

Typically, tow tug and tow vehicle operators receive training and licensing for surface operations from the airport operator. Depending on the airport, this situation is not always the case. Training, where available, is not standardized and "best practices" are not shared between airports.

The co-leads for this objective are Airports and Flight Standards. Participating organizations include airlines, FBO's, and airport associations.

Goal 4. Improve runway safety data collection, analysis, and dissemination

Three objectives have been defined under this goal

Objective 4.1 - Disseminate and provide training for the Runway Incursion Information Evaluation Program (RIIEP) to all FAA Safety Inspectors. Develop data collection and analysis system that provides report and trend information regarding runway incursions caused by pilot deviations that can be used by safety inspectors, flight instructors, examiners and others.

The Runway Incursion Information Evaluation Program (RIIEP) has been extended, but initial program efforts were not sufficient. New investigative questions have been developed. Experience from the first year of implementation has provided better insight and experience that will be incorporated into the program. Data collection and analysis requires improvement.

The lead organization is Flight Standards. Participating organizations include System Safety, associations, and labor organizations.

Objective 4.2 - Improve runway safety data collection, storage, retrieval and distribution

Data and information useful for improving runway safety is contained in multiple databases operated by different organizations. Due to differences in database design, data collected, physical location and updating processes for these existing databases, it is difficult to conduct thorough data analyses. Information extracted and accurate data analyses are critical to identifying and prioritizing safety activities.

The lead organization for this objective is the Office of Runway Safety. Participating organizations include Air Traffic, Flight Standards, System Safety, and Airports.

Objective 4.3 – Improve the collection and analysis of operational error data by supporting the implementation and dissemination of the JANUS tool throughout the air traffic control environment.

The current data gathering and analysis techniques are inadequate for determining the root causes of human error. JANUS is a an innovative interview technique that combines human factors science, air traffic control expertise, and custom software into a tool designed to identify the individual and systemic root causes of human error in the ATC system. JAUNS was developed for AAT-200 Investigations and has been adapted for application to the airport surface environment. JANUS is currently in the Beta testing stage. JANUS also has flight deck and vehicle operator versions that are in the development process.

The lead organization for this objective is the Office of Runway Safety. Participating organizations include Air Traffic and labor organizations.

Goal 5. Identify and implement enhancements to improve surface communications

Three objectives have been defined under the goal to improvement in communications between controllers and pilots.

Objective 5.1 – Complete and publish results from Phraseology Workgroup.

Work accomplished as the result of the Pilot-Controller Phraseology near-term initiative needs to be completed. Recommendations were developed and forwarded for negotiations and final decision.

The lead organization for this objective is Air Traffic. Participating organizations include Flight Standards and labor organizations.

Objective 5.2 – Evaluate, and if appropriate, implement national procedures that require read backs of any clearance to enter a specific runway, hold short of a specific runway, or taxi into position and hold instructions.

A fundamental design feature of the air traffic system requires checks and balances between controllers and pilots working in the system; each working to recognize and correct errors introduced by the other. This objective serves to enhance this likelihood in the runway environment.

The co-leads for Air Traffic and Flight Standards. Participants include labor organizations.

Objective 5.3 – Publish guidance on standard surface operations phraseology guidance for pilots and mechanics moving aircraft.

Improving clarity and understanding of communications will reduce opportunity for confusion and mistakes on the surface, thereby reducing the potential for runway incursions.

The lead organization is the Office of Runway Safety. Participating organizations include Air Traffic, Flight Standards, Airports, and industry associations.

Goal 6. Increase situational awareness on the airport surface

Four objectives have been defined for this goal.

Objective 6.1 – Issue guidance on vehicle operations near active runways.

Holding position markings and signs are located on taxiways back from runways in order to protect the runway safety areas (RSA) and the obstacle free zones (OFZ) on the movement area. However, the RSA and the OFZ continue along the full length of the runway and extend beyond the ends. These two areas are to ensure that an aircraft landing or taking off will not run into any unnecessary obstructions if it is unable to follow the runway centerline. This guidance would basically prohibit personnel and equipment in the RSA and OFZ during aircraft operations, providing a higher degree of safety for aircraft.

The lead organization is Airports. Participating organizations include Airway Facilities, Air Traffic, and industry associations.

Objective 6.2 - Complete the airport paint marking study and revise standards in the advisory circular, if appropriate based on a review of study results by the Office of Airport Safety and Standards.

Almost every paved airport, regardless of size, uses paint to provide guidance and navigation information to pilots as they operate on the paved surface. Standards for surface markings have been established through an evolutionary process. This study would take a broader look at paint markings and would include knowledge gained from markings used in other transportation environments (e.g., highways). The purpose of this objective is to determine if there are any marking methods, uses or designs not currently being used that could improve surface situational awareness of pilots and drivers on the airport surface. Proposed markings would be tested in a simulator and in the field. Changes, if appropriate, would be made to standards in the advisory circular based upon acceptance of study outcomes.

The co-leads for this objective are Airports and the Office of Runway Safety. Participants include industry and association representatives.

Objective 6.3 - Complete airport design and operations study and develop airport configuration and operational procedures enhancements in sufficient detail to evaluate at least one airport in an operational environment. Enhance design standards and improve procedures as appropriate.

Most U.S. airports were built to handle propeller driven aircraft at much lower volumes of traffic than today's jet flights. Capacity demands have added runways and taxiways to these existing designs, creating areas that result in increased surface incidents and runway incursions. This study will evaluate airport designs, will identify configuration improvements and will propose potential procedural changes to enhance safety. Changes, as appropriate, will be made to design standards and procedures.

The lead organization is the Office of Runway Safety. Participating organizations include Airports, Air Traffic, Flight Standards, and representatives from labor, industry, and associations.

Objective 6.4 – Ensure towered airports have current airport diagrams by the end of December 2003 and they are available in Government publications. Clarify process, roles and responsibilities for development and maintenance of airport diagrams.

Airport diagrams are available in Airport/Facility Directories and in U.S. Terminal Procedures publications and various websites. Typically, if an airport has an instrument approach, there is a corresponding airport diagram. All airports with control towers do not yet have diagrams published.

The lead organization is Air Traffic. Participating organizations include Airports, the Office of Communications, Navigation, and Surveillance Systems, and the National Aeronautical Charting Office.

Goal 7 - Support and deploy new technologies that reduce the potential for collision

Seven objectives have been defined under the technology goal.

Objective 7.1 – Maintain the published AMASS deployment waterfall schedule.

AMASS is a hardware and software enhancement for the Airport Surface Detection Equipment-Model 3 (ASDE-3) radar system that provides safety warnings and alerts of potential runway collisions. This system will be installed at all ASDE-3 sites and is currently going through local adaptation, testing and commissioning. A schedule has been published for these activities.

The lead organization is the office of Communications, Navigation, and Surveillance Systems. Participating organizations include Air Traffic, Airway Facilities, and labor organization representatives.

Objective 7.2 – Develop high-level requirements for Runway Status Lights (RWSL) and validate alternative implementation methods through conduct of field demonstrations.

The RWSL system detects the presence and motion of aircraft and surface vehicles on or near the runways, assesses possible conflict with other surface traffic, and illuminates runway-entrance lights if the runway is unsafe for entry or crossing. The RWSL system may also have the ability to illuminate takeoff hold lights if the runway is unsafe for departure.

The RWSL system was initially evaluated in the mid-1990's at Boston Logan airport. Results from that evaluation proved that the lights could be driven automatically using computer processing of integrated surface and approach surveillance information. Current development will expand on the results of the Logan evaluation and include multiple surveillance sources (i.e., AMASS, ASDE-X).

The lead organization is Air Traffic. Participating organizations include Flight Standards, Human Factors Division, System Safety, the office of Communications, Navigation, and Surveillance Systems, Airports, labor and pilot associations.

Objective 7.3 – Conduct evaluations of existing low-cost technologies.

During 2001 and early 2002, numerous contracts were awarded for various low-cost technologies that have potential safety benefits for airport surface operations. Initial demonstrations have begun for these technologies and are scheduled to be completed in 2002. Some appear to possess potential safety benefits and are feasible candidates for implementation. Based upon results of evaluations and funding, selected technologies will be installed at candidate airports. Low-cost technology airport assessments are underway in a parallel effort.

The lead organization is the Office of Communications, Navigation, and Surveillance Systems. Participating organizations include Air Traffic, Flight Standards, Human Factors Division, Airports, labor and pilot associations.

Objective 7.4 – Meet published ASDE-X milestones.

ASDE-3 radars have been installed at 33 of 34 major airports. No additional ASDE-3 radars are available. To meet surveillance needs at additional airports, a new system, ASDE-X, was developed. A contract has been awarded for this system and it is currently in development. First site operational readiness date is planned for FY 2003. ASDE-X will enhance airport surface surveillance at 33 airports.

The lead organization is the Office of Communications, Navigation, and Surveillance Systems. Participating organizations include Air Traffic, Airway Facilities, and labor organization representatives.

Objective 7.5 – Evaluate moving map technologies in an operational environment – using either aircraft or surface vehicles.

Studies have shown that a pilot's lack of situational awareness is a major factor precipitating runway incursions and that a moving map display system is one of the most effective pilot interventions for runway incursion prevention. Current surface navigation techniques and technologies have changed little over the past 30 years. Meanwhile, multi-function displays and satellite-based navigation equipment have been installed in some commercial and business aircraft for use while in flight. There is a range of hardware solutions either under development or available for moving map technologies ranging from a hand-held device to a moving map integrated into the primary flight display. The range of implementation solutions is provided to address the diversity of aircraft type, operational capabilities, and funding priorities.

This objective would result in publishing the necessary additional diagrams, and would encompass the publishing of digital maps for at least 75 airports in accordance with RTCA DO-272 User Requirements for Aerodrome Mapping Information (dated October 2001), and the establishment of procedures for configuration, control and maintenance of a digital map database.

The lead organization is the Office of Communications, Navigation, and Surveillance Systems. Participating organizations include Airway Facilities, Regulation and Certification, Airports, airlines, and pilot associations.

Objective 7.6 – Develop and evaluate a visual signal that provides direct warning to flight crews on final approach when the runway is occupied.

When pilots are on final approach for landing, in certain conditions such as haze or nighttime, it is difficult to distinguish an aircraft that is already on the runway and pointing directly away from an arriving aircraft. A visual method to warn pilots (operating in sufficient visibility) that the runway is occupied would reduce the opportunity for collision.

The lead organization is the Office of Communications, Navigation, and Surveillance Systems. Participating organizations include Airports, Air Traffic, airlines, and labor and pilot associations.

Objective 7.7 – Develop a surface "road map" for a low-cost technology architecture and periodically release Broad Agency Announcements (BAA) to solicit industry surface safety technology ideas and concepts. Field active and passive systems that increase situational awareness in the control tower and the cockpit as they become available.

The FAA has started a proactive activity that includes developing a surface system "road map" that will identify a set of requirements and a basic architecture to address communications, data link, surveillance, display systems and safety warning systems that can be used on the airport surface. The document will also identify standard interfaces and a method for quickly implementing and certifying low-cost surface systems. Existing and new low-cost technologies will be mapped to this document to ensure compatibility and completeness.

The lead organization is the Office of Communications, Navigation, and Surveillance Systems. Participating organizations include Airports, Air Traffic, airlines, airport management, and labor and association representatives.

Goal 8 - Implement site-specific runway safety solutions in coordination with local aviation communities

Two objectives are defined under this goal:

Objective 8.1 - Create and accomplish a regional runway safety plan for each FAA region (every 18 to 36 months) tailored to specific operational and geographical needs. Plans should include appropriate Runway Safety Action Team (RSAT) site visits to airports within each region.

Blueprint 2002-2004 has been updated to address broad objectives that are best addressed from a national level. However the bulk of runway safety work is accomplished at the regional and local levels. Plans need to be developed at each region that take the National goals and objectives, and describe how they will be implemented and achieved.

The lead organizations for this objective are the Regional Administrators. Participating organizations include regional Air Traffic, Flight Standards, Airports, and Airway Facilities Divisions and the regional Runway Safety Program Managers.

Objective 8.2 – Implement an aggressive runway safety "special emphasis" at selected airports that results in reducing runway incursions.

Increased runway safety benefits can be achieved through addressing high severity and high frequency incursion trends at selected airports. This objective is focused at developing "best practices" to reduce runway incursions when an airport is selected for enhanced runway safety focus.

The lead organizations for this objective are the Regional Administrators. Participating organizations include regional Air Traffic, Flight Standards, and Airports Divisions, and regional Runway Safety Program Managers.

The 2002-2004 Runway Safety Blueprint

Appendix A

Runway Incursion Joint Safety Implementation Team (RI JSIT) Summary

The Director of the Office of Runway Safety along with Commercial and General Aviation counterparts have, as tri-chairs, led the RI JSIT to develop the joint Safety Enhancements that have the greatest potential for improving runway safety. The Commercial Aviation Safety Team (CAST) approved 11 of the 22 RI JSIT Safety Enhancements for implementation in March of 2002. The Office of Runway Safety has incorporated within its Objectives those approved enhancements**. Figure A.1 shows the relationship of CAST approved Safety Enhancements with the corresponding 2002-2004 Runway Safety Blueprint Objectives.**

CAST Approved Safety Enhancements	CAST Enhancement	Encompassed in Objective(s)
SOPs - Ground operations	49	3.4
SOPs - Ground operations for GA	50	3.4
SOPs - Tow tug operators	51	3.6
SOPs - Vehicle operators	52	3.6
Air Traffic Control Training -Enhanced tower controller training	46	1.1 & 1.6
Air Traffic Control Training -Tower Controller CRM Training	47	1.7
ATC Procedures - SOPs for controller situational awareness	55	3.2
ATC Procedures - Read back requirement	59	5.2
Situational Awareness Technology for ATC -Enhanced airport surveillance equipment	53	7.7
Visual Aids Enhancement and Automation Technology - Airports -Runway occupancy signal	44	7.6
Pilot Training - One project/SA, SOPs, CRM, All Resources	60	1.1-1.3, 1.8, 2.2, & 4.1

(Figure A.1)

The remainder of Appendix A is a Draft summary of the work that the RI JSIT has developed that is still pending CAST approval. It entails the role of the RI JSIT in CAST, the method in which the enhancements were derived, and the overview for each of the implementation plans developed.

The Runway Incursion Joint Safety Implementation Team (RI JSIT) was chartered by the Commercial Aviation Safety Team (CAST) and General Aviation Joint Steering Committee (GA JSC) to develop a plan to effectively reduce the severe threat of fatalities and loss caused by commercial and general aviation runway incursion collisions/incidents. CAST's goal is to reduce the US commercial aviation fatal collision rate by 80% by the end of the year 2007. To help accomplish this goal, the RI JSIT brought together expert representatives from across the aviation community including participants from government, industry, and pilot and controller unions. These experts developed, prioritized, and coordinated a plan to implement the most effective analytically data-driven intervention strategies recommended by the Runway Incursion Joint Safety Analysis Team (RI JSAT). Those 115 intervention strategies were joined with 37 GA JSC intervention strategies and were analyzed by the RI JSIT to determine the feasibility of gaining significant safety benefits through implementation. From the overall effectiveness

and feasibility scores, twenty-two "Safety Enhancements" were incorporated into seven Detailed Implementation Plans.

FAA data on runway incursion incidents and collisions from 1997-2000 reflects that 55% are caused by pilot deviations, 25% are caused by controller operational errors, and the remaining 20% are caused by vehicle or pedestrian deviations. Further break down of this data indicates that of Category A and B runway incursions, 54% are due to pilot deviations, 35% are controller operational errors, and the remaining 11% are vehicle or pedestrian deviations.

An executive overview of the seven Detailed Implementation Plans follows:

Standard Operating Procedures (SOPs) for Ground Operations

Standard Operating Procedures (SOPs) have been among the highest scoring safety enhancements across five collision categories including Controlled Flight into Terrain, Approach and Landing, Loss of Control, Runway Incursion, and Turbulence. The implementation of Standard Operating Procedures (SOPs) for surface operations is one of the most powerful near-term interventions in mitigating the risk of runway incursions. This project would build upon Advisory Circular 120-74, "Flight Crew Procedures During Taxi Operations," to develop templates of SOPs. These templates would be used by air carriers, general aviation pilots, and ground personnel who tow or otherwise operate aircraft on the airport surface.

Just as pilot deviations in the air (e.g., altitude deviations) have been reduced by increased standardization of cockpit procedures, the incidence of runway incursions and other surface incidents could also be reduced by increased standardization of pilot procedures for ground operations. Although most airlines have detailed procedures for airborne operations, relatively few airlines have standard procedures for operating in the increasingly complex surface environment. The purpose of this project is to reduce the risk of runway incursions and surface incidents by recommending that all TITLE 14 CFR Part 121 operators and Part 135 operators: establish, document, train to, and follow, standard operating procedures (SOPs) for ground operations.

The enhancements, recommended in the SOP for the ground operations plan, call for:

1. Developing SOPs from a survey of industry "best practices". Operators would implement these SOPs by training to proficiency and ensuring their use.
2. Adapting these best practices for use in single-pilot (Part 91) operations.
3. Developing "best practices" for ground personnel that taxi or tow aircraft on the airport movement area.
4. Developing "best practices" for ground vehicle operations in the aircraft movement area and incorporating them into training programs for drivers.

This plan is highly cost-effective, and could be implemented immediately with minimal additional effort on the part of the air carriers. With industry-wide implementation of the proposed SOPs, pilot behavior would become more standardized, and less likely to result in a runway incursion.

Air Traffic Control Training

More than a third of the Category A and B runway incursions have been attributed to controller operational errors. These errors have been attributed to: memory lapses, a lack of controller teamwork, improper scanning, poor prioritization of duties, and on-the-job training (OJT) being conducted during actual operations. All of these causal factors

could be mitigated by the interventions proposed by the ATC Training Detailed Implementation Plan. The initiatives within this plan are interdependent and should be viewed as a whole.

1. Training controllers on the capabilities and limitations of human memory is an important first step in preventing operational errors due to controller memory lapses. Providing controllers with tools to help manage their memory resources while working in ever-changing, dynamic conditions can help prevent memory lapses, and prevent and correct these errors before they develop into incidents or collisions.
2. Air Traffic Controller course curriculums for initial and refresher training need to be revised to ensure that controllers utilize the essential skills of scanning, anticipated separation, and prioritization of control duties. Notably, these skills could be taught and strengthened with simulator training.
3. Team effectiveness training would provide a version of cockpit resource management (CRM) for all tower controllers. This training fosters a culture of teamwork in the tower environment to help prevent, detect, and correct controller and pilot errors before they result in runway incursions and collisions.
4. Currently, tower controllers do not benefit from training in visual simulators. Simulators have been recognized as a successful and cost-effective means for flight training for decades and it is the industry standard to provide training in simulators for emergencies and unusual situations. Simulators provide an optimum environment for training to improbable, but safety-critical situations. Providing training for controllers in a visual high-fidelity tower simulator is an efficient, effective use of resources. Also, the use of simulators for initial controller training would ensure that this training is conducted with no risk to the flying public. Finally, providing initial training in a simulator would cut training time, and increase the knowledge base and experience of new hires before they work in an operating tower. This will become increasingly important with the expected attrition due to retirement and the concurrent influx of hundreds of new controllers.

Air Traffic Control Procedures

The ATC Procedures project will help to reduce the incidence of runway incursions by:

- Increasing controller situation awareness
- Reviewing (and revising as necessary): capacity enhancement programs, required controller and pilot phraseology, and implicit instructions to cross a runway.

These two objectives will be accomplished by:

1. Establishing national standards for tower control positions to help promote increased situational awareness for controllers with respect to surface operations.
2. Reviewing capacity enhancement programs to determine whether they contribute to surface incidents. If so, they would be revised or eliminated.
3. Reviewing phraseology used for surface operations for efficiency and clarity, and revising as needed.
4. Conducting a study to determine whether revising TITLE 14 CFR 91.129(i) would help reduce runway incursions.
5. Initiating rulemaking to require that pilots read back all instructions to: “hold short”, “taxi into position and hold” or otherwise enter a runway.

Situational Awareness Technologies for Air Traffic Control

This project will develop and implement technology tools to provide and/or enhance airport surface situational awareness for air traffic controllers. Examples of these technology tools include, but are not limited to, Airport Movement Area Safety System (AMASS), Airport Surface Detection Equipment (ASDE-X), Automated Dependent Surveillance – Broadcast (ADS-B), Next Generation Air-Ground Communications System (NEXCOM), and Surface Movement Advisor (SMA). These technologies will also support pilots with a clear understanding of airport layout and clearance instructions to avoid deviations in all visibility conditions. The implementation of these interventions would be accomplished through the following activities:

1. New technology tools would be developed by the FAA to enable enhanced surveillance, information, communication and conflict detection for ATC operations.
2. FAA and airport operators would provide airport surface surveillance equipment with conflict alerting capability at air traffic control towers.
3. Digital data link capability would be developed and implemented to enable automatic transmission of ATC instructions/information (between the ground and aircraft).
4. Situational Awareness Displays developed in support of the above listed strategies would incorporate industry best practices for computer-human interface (CHI) design to enhance and support ATC decision-making.

Visual Aids Enhancement and Automation Technology for Airports

Numerous runway incursion incidents and collisions have resulted from pilot and vehicle operator ground movement navigation errors. Substantially improved ground movement navigation guidance is needed to prevent such collisions and incidents. The four Visual Aids Enhancement & Automation Technology Project safety enhancements that follow provide the capability to present needed information in the normal field of view of pilots and vehicle operators:

1. Variable message signs would have the capability to present critical clearances such as “hold”, “cross” or “take-off”.
2. Improved airfield marking & lighting would enhance the conspicuity of runway and taxiway centerlines and other critical airport markings.
3. Providing runway occupancy information to pilots on final approach would prevent collisions and incidents due to a “land over” where an aircraft on final approach jeopardizes, or collides with, an aircraft on the runway awaiting takeoff clearance.
4. “Smart” ground movement lighting that indicates the taxi route clearance would substantially reduce runway incursions resulting from pilots getting lost and proceeding onto a runway or taxiway without a clearance.

Pilot Training

Pilot deviations account for more than half of all runway incursions. Enhancements to pilot training would substantially contribute to runway safety by helping pilots to avoid, detect, and correct errors before they result in runway incursions. By increasing the number of surface movement tasks on written and practical test standards, and by incorporating new and revised training material, significant improvements in pilot training can be achieved. The training material would entail:

- Increasing situational awareness in the airport environment
- Effective pre-taxi planning and briefing
- Use of standard operating procedures for surface operations
- Task prioritization
- Effective crew resource management

These interventions proposed by the pilot training workgroup would be implemented through the existing infrastructure within the FAA and industry. Policies, procedures, and implementation guidelines for pilot training programs to prevent runway incursions would be developed and implemented using resources available to FAA, GA, military, and air carrier pilots (such as advisory circulars, and safety material compiled from government, industry, academia and DOD).

Aircraft / Vehicle Upgrade and Installation (Moving Map Display)

The Runway Incursion JSIT determined that the moving map display systems were the most powerful intervention for runway incursion prevention. As mentioned previously, pilot deviations account for more than half of all runway incursions. The RI JSIT estimated that nearly half of these deviations could be prevented using a moving map display with only GPS own-ship position. Using the JIMDAT process, the RI JSIT determined that a moving map display with own-ship position and airport traffic displayed (e.g., ADS-B/TIS-B), would have been highly effective in preventing the runway incursion collisions and incidents considered by the RI JSAT. Further enhancements such as runway occupancy alerting and graphical taxi clearances, would provide additional benefits.

There is a range of hardware solutions to implement these capabilities, from that of a hand-held device to a moving map integrated into the primary flight display. This range of implementation solutions is provided to address the diversity of aircraft type and operational capabilities.

While cost remains the biggest barrier to implementation, a phased approach is proposed which minimizes cost and provides an immediate and measurable safety benefit. The initial phase will address the development and installation of an airport moving map cockpit display with own-ship position (enabled by GPS). Subsequent phases will address the addition of data-linked traffic information, runway occupancy advisory systems, and taxi routes and clearance limits. Operational benefits achieved through the implementation of moving map technologies (such as those that will enhance capacity and efficiency) will also help to offset equipage investment.

The enhancements proposed in these plans would reduce the number of runway incursions by:

1. Improving pilot situational awareness with the implementation of moving map displays in the cockpit. This is proposed as a voluntary equipage with a phased implementation. The first phase provides the capability of a moving map showing GPS own-ship position. The second phase adds traffic to the display via data link technologies. The third phase adds runway occupancy advisories. The final stage adds graphical and/or textual presentation of taxi clearances and clearance limits.
2. Improving situational awareness of airport vehicle drivers with the voluntary implementation of moving maps in vehicles that operate on the airport. This would help prevent runway incursions caused by driver error and enhance their understanding of the operations on the airport.

Recommendations

- The unifying goal of the Runway Incursion JSIT was to produce a practical agenda yielding significant safety benefits, not for a selected group of organizations, but for the entire commercial aviation community. Because not all organizations comprising the general and commercial aviation communities are represented on CAST and GA JSC, the RI JSIT recommends:
- That this report be treated as a public document,
- That CAST and GA JSC ensure prompt distribution of this report to all major organizations comprising the U.S. commercial and general aviation community, the presidents of IATA, IFALPA, the Chairman of the JAA Board, and the President of the Council of ICAO.

Additionally, the RI JSIT is the only one of the first five JSAT and JSIT teams to study incident data. As industry and government collectively move toward a National Strategic Plan for Aviation Safety, they will be required to increasingly move from a reactive to a preventive model of mishap elimination. Achieving the next order of magnitude reduction of risk in aviation may require an expanded focus on other sources of data (e.g., incident data as well as collision data) to identify the precursors of catastrophe. The move from studying primarily collision data to a reliance on incident data will require improved data collection systems, procedures, and protections among all the stakeholders within the aviation community.

Most importantly, the RI JSIT recommends that CAST and its member organizations implement the seven projects identified as soon as possible.

Participating RI JSIT Organizations

The following is a list of participating RI JST organizations. Airports Council International North America (ACI-NA), Airborne Express Airline, Air Line Pilots' Association (ALPA), Air Transport Association (ATA), Aircraft Owners and Pilots Association (AOPA), Allied Pilots Association (APA), American Airlines, American Association of Airport Executives (AAAE), Boeing Company, Department of Defense (DoD), Experimental Aircraft Association (EAA), Federal Aviation Administration (FAA), Federal Express (FedEx), General Aviation Manufacturers Association (GAMA), HNTB Corp/ ACI, National Aeronautics and Space Administration (NASA), National Air Traffic Controllers Association (NATCA), National Air Transportation Association (NATA), Northwest Airlines, Regional Airline Association (RAA), Rockwell Collins, United Airlines, United Parcel Service Airline (UPS), United Parcel Service Aviation Technologies (UPS AT), DOT/Volpe Center.

Appendix B – Common Terms and Definitions

Runway Incursion

"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."

Runway incursions are identified and tracked at towered airports (those airports with an operating FAA or contract tower). Runway incursions are further classified into three operational categories and four severity classifications.

Operational Categories:

Operational Error (OE)	An action taken by an air traffic controller that causes a loss of separation as defined in FAA Order 7210.56A. An operational error results in one of the following: Less than the applicable separation minimum between two or more aircraft or between an aircraft and terrain or obstacles, as required by FAA Order 7110.65, air traffic control, and supplemental instructions. Obstacles include vehicles/equipment/personnel on runways; an aircraft landing or departing on a runway closed to aircraft operations after receiving air traffic authorization.
Pilot Deviation (PD)	An action taken by a pilot that results in violation of Title 14 of the Code of Federal Regulations.
Vehicle/Pedestrian Deviation (VPD)	An entry or movement on the airport movement area by a vehicle (including an aircraft operated by a non-pilot) or a pedestrian that has not been authorized by air traffic control.

Severity Classifications:

Category A	Separation decreases and participants take extreme action to narrowly avoid a collision, or the event results in a collision. These runway incursions are typified by: the immediate need for corrective action by ATC and/or evasive action by a flight crew, or the lack of corrective/evasive action. The collision either occurs or is narrowly avoided by chance. These runway incursions are characterized by events, with at least one aircraft traveling at a high speed or speed sufficient to cause substantial damage with the potential for injury or fatalities.

Category B	Separation decreases and there is a significant potential for a collision. Level B events are characterized by the need for a time-critical corrective/evasive action that was, or could have been, taken by ATC or the flight crew. These situations are typified by critical errors, which under different circumstances or aircraft performance or the timing of ATC clearances or instructions, could have lead to a barely avoided collision.
Category C	Separation decreases, but there is ample time and distance to avoid a potential collision. In cases where no corrective action was taken, the collision risk is reduced by a significant level based on available time, distance margin, and aircraft performance. These situations are typified by critical errors, which under different circumstances of aircraft performance, or the timing of ATC clearances or instructions, could have lead to a higher potential for collision. Participants in these incidents usually do not come in close proximity at high speed.
Category D	Little or no chance of collision, but meets the definition of a runway incursion.
Surface Incident:	"An event during which unauthorized or unapproved movement occurs within the movement area or an occurrence in the movement area associated with the operation of an aircraft that affects or could affect the safety of flight."
FAA Lines of Business (LOB)	Air Traffic Services Regulation and Certification Airports Research and Acquisition
Towered Airport Operation	"A takeoff or landing at an airport with an operating federal or contract air traffic control tower."

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Appendix C -- Acronyms

AAAE	American Association of Airport Executives
AC	Advisory Circular
ACI	Airports Council International
AFSS	Automated Flight Service Stations
ALPA	Air Line Pilots Association
AMASS	Airport Movement Area Safety System
AOPA	Aircraft Owners and Pilots Association
APA	Allied Pilots Association
ARC	Regional and Center Operations
ARI	Office of Runway Safety
ASDE-3	Airport Surface Detection Equipment - Model 3
ASDE-X	Airport Surface Detection Equipment - Model X
ASRS	Aviation Safety Reporting System (NASA Program)
ASY	Office of System Safety
ATC	Air Traffic Control
ATTE	Air Traffic Teamwork Enhancement
BAA	Broad Agency Announcement
CAST	Commercial Aviation Safety Team
CD-ROM	Compact Disk - Read Only Memory
CFR	Code of Federal Regulations
CY	Calendar Year
DOT	Department of Transportation
DOT OIG	Department of Transportation Office of Inspector General
DUATS	Direct User Access Terminal Service
FAA	Federal Aviation Administration
FBO	Fixed Base Operator
FY	Fiscal Year
GA JSC	General Aviation Joint Steering Committee
JIMDAT	Joint Implementation Data Analysis Team
LAHSO	Land And Hold Short Operations
LOB	Line of Business
NAATS	National Association of Air Traffic Specialists
NACO	National Aeronautical Charting Office
NAFI	National Association of Flight Instructors
NAS	National Airspace System
NASA	National Aeronautics and Space Administration
NATCA	National Air Traffic Controller Association
NOTAM	Notice to Airmen
NTSB	National Transportation Safety Board
OE	Operational Error
PD	Pilot Deviation
RIIEP	Runway Incursion Information Evaluation Program
RI JSIT	Runway Incursion Joint Safety Implementation Team
RSAT	Runway Safety Action Team
SOP	Standard Operating Procedure
VPD	Vehicle/Pedestrian Deviation