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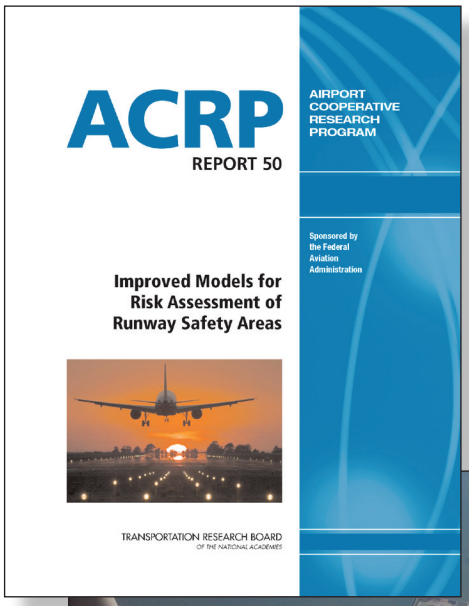
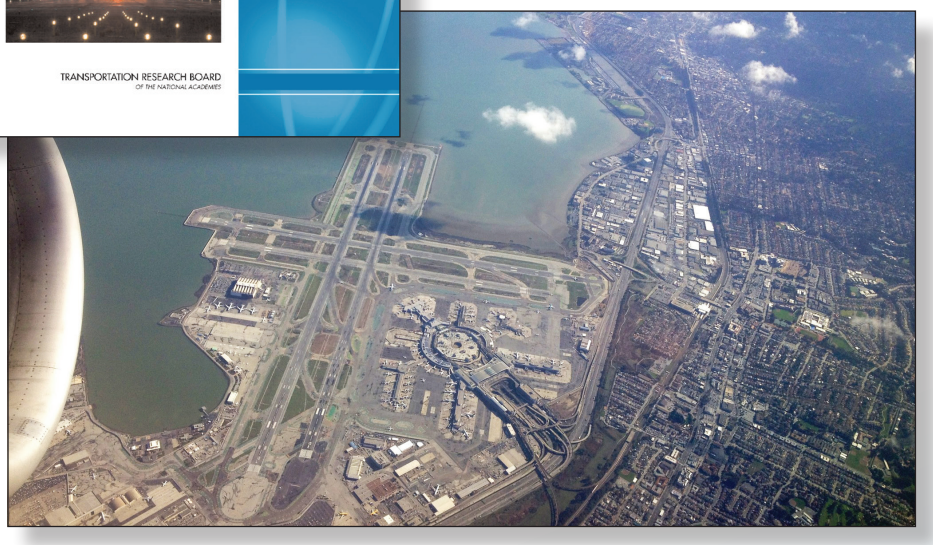
Improving the Safety of Runway Safety Areas

Runway safety areas (RSAs) surround the area of an airport's runway and should, under normal conditions, be capable of supporting aircraft without causing damage to the vehicle or injury to the passengers. In the 1960s, the FAA increased the regulated size of RSAs in order to reduce the severity of aircraft incidents. However, because many airports were built before the 1960s, many runways did not comply with the new dimensions.



Airports in the United States are required by law to improve RSAs and comply with new FAA design standards by the end of 2015. For some airports, terrain and environmental challenges make it impractical to extend RSAs, so these facilities seeks to improve runway safety in other ways. In many cases, it is impossible to achieve 100% of the new requirements that apply to runways constructed since the regulations went into effect. The FAA works closely with airports to achieve as much of the required safety area that is physically, economically, and politically possible.

ACRP Report 50: Improved Models for Risk Assessment of Runway Safety Areas focuses on safety considerations of airport RSAs. This report builds on earlier research introduced in *ACRP Report 3: Analysis of Aircraft Overruns and Undershoots* for Runway Safety Areas, which was used to introduce a methodology for risk assessment of RSAs. Risk assessments are used to predict the likelihood of common accidents at airports and to help inform airports' efforts to improve the safety of RSAs. *ACRP Report 50* expands on the earlier report to incorporate several additional methodologies for improving RSAs.



Above: Aerial view of runways at San Francisco International Airport. SFO utilized ACRP Report 3 *and* ACRP Report 50 *to help identify cost-effective alternatives for achieving 97% of FAA safety requirements to improve its runway safety areas. Image by Sam Wheeler (commons.wikimedia.org/wiki/File:SFO_Aerial_View.jpg), licensed under CC-BY-SA-3.0: (creativecommons.org/licenses/by-sa/3.0/us/).*

Four primary alternatives to improve an RSA are identified in *ACRP Report 50*, including:

- Extend the RSA laterally and longitudinally;
- Modify or relocate the runway to expand the RSA;
- Reduce the declared distance available for sudden stops or takeoffs; and
- Install an engineered material arresting system (EMAS).

The report analyzes these alternatives, individually and in combination, to provide guidance to airport operators looking to improve the safety of their RSAs.

ACRP Report 50 authors completed a functional hazard analysis for the type of incidents that relate to an airport's RSA, including landing overruns, landing veer-offs, landing undershoots, takeoff veer-offs, and takeoff overruns. Analyzing more than 1,400 accidents and incidents that occurred since 1980, the team developed a three-part risk model that evaluates the probability of the event given certain operating conditions including aircraft performance and weather conditions; the probability of occurrence at a given location given RSA characteristics, geometry, and presence of EMAS; and the consequences of the event.

The report includes a user's guide to software called *RSARA*, developed as part of the project, which can perform a full risk assessment for individual or multiple runways. Users enter the airport's

continued on page 2

historical operations data, historical weather data, characteristics of runways, characteristics of the RSAs, and general information about the airport. From this data the software generates the average risk for each type of incident by runway, by RSA section, and the airport's total risk. The model was validated against the actual historic accident rate at a sampling of airports that were representative of conditions across the United States.

San Francisco International Airport (SFO) had several runways that fell within FAA requirements for improved safety. A SFO task force charged with studying the improvements identified approximately 30 alternatives that would improve the airport's level of safety, but possibly at great cost. On one side, the airport is bounded by a major highway, and on the other, it is bounded by the San Francisco Bay. Furthermore, the airport had very little data to help determine the best alternative. At the time of the study, the airport had experienced no accidents.

John Bergener, with the SFO Bureau of Planning and Environmental Affairs, was directed to the two ACRP reports by the FAA. Using tools and guidance from the reports, with consultation from report author Applied Research Associates, SFO was able to identify two cost-effective alternatives for achieving 97% of the FAA safety requirements. Ultimately, the airport chose to shift the location of runways and to use EMAS.

Bergener explained that, "Achieving the full 100% of the safety standard would have cost the airport at least several hundred million dollars. The methodology helped us to come to the decision we ultimately did. The airport was safe before we made the improvements, and now the airport is even more safe."

Michael Lawrance, former SFO airport planner and now a senior aviation planning specialist with the FAA, recalls that the SFO project team worked hard to consider every alternative. "The information we received [from the ACRP reports] helped give us confidence that we were doing what we thought we should do," Lawrance recalled. "It gave the project team more confidence that we were making the right decision."

> Landing and takeoff overruns, undershoots, and veer-offs account for most of the accidents that occur on or near the runway. Conditions at the airport may contribute significantly to the probability and severity of the accidents. The runway safety area (RSA) improves the safety of airplanes and has helped turn potential accidents into minor incidents.
>
> —*ACRP Report 50: Improved Models for Risk Assessment of Runway Safety Areas*

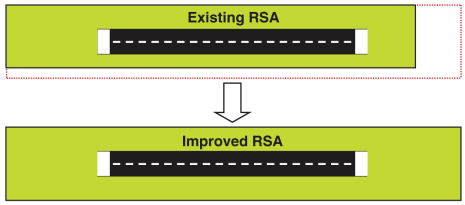


Figure 1. Extending the RSA.

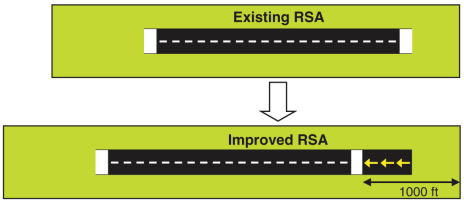


Figure 2. Relocating the runway.

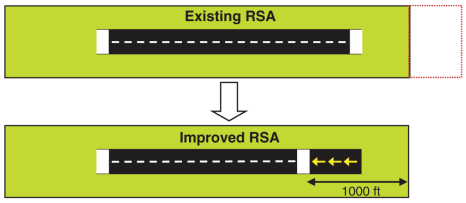


Figure 3. Using declared distances.

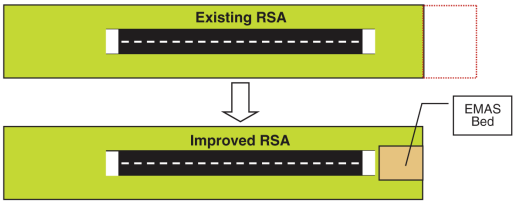


Figure 4. Using EMAS.

Above: Figures from ACRP Report 50 *illustrating the four basic alternatives available to airports for improving a runway safety area when it does not meet current FAA design standards. The report describes the advantages and disadvantages of each alternative specific to an airport's situation that need to be assessed.*

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