This product is part of the RAND Corporation documented briefing series. RAND documented briefings are based on research briefed to a client, sponsor, or targeted audience and provide additional information on a specific topic. Although documented briefings have been peer reviewed, they are not expected to be comprehensive and may present preliminary findings.

DOCUMENTED
BRIEFING

Implementing Security Improvement Options at Los Angeles International Airport

Donald Stevens, Thomas Hamilton, Marvin Schaffer,
Diana Dunham-Scott, Jamison Jo Medby,
Edward W. Chan, John Gibson, Mel Eisman,
Richard Mesic, Charles T. Kelley, Jr.,
Julie Kim, Tom LaTourrette, K. Jack Riley

Prepared for the Los Angeles World Airports

INFRASTRUCTURE, SAFETY,
AND ENVIRONMENT

The research described in this report was conducted under the auspices of the Homeland Security program within RAND Infrastructure, Safety, and Environment (ISE) for Los Angeles World Airports.

Published 2006 by the RAND Corporation
1776 Main Street, P.O. Box 2138, Santa Monica, CA 90407-2138
1200 South Hayes Street, Arlington, VA 22202-5050
201 North Craig Street, Suite 202, Pittsburgh, PA 15213-1516
RAND URL: http://www.rand.org/
To order RAND documents or to obtain additional information, contact
Distribution Services: Telephone: (310) 451-7002;
Fax: (310) 451-6915; Email: order@rand.org

SUMMARY

The RAND Corporation was commissioned by LAWA to conduct a series of studies on options for protecting LAX from terrorism. In October 2004, Stevens et al. described RAND's studies and recommended protective actions that could be taken at LAX. In November 2005, RAND was asked to identify how key recommendations from the 2004 documented briefing could be implemented. In addition, RAND was asked to examine if adding security film to the windows facing the Central Terminal Area (CTA) was a cost-effective solution to the car bomb threat at LAX. The CTA encompasses the eight terminals, the horseshoe shaped public roadway, and the central parking area.

This documented briefing summarizes the findings from our 2004 documented briefing (Stevens et al.), examines what has changed at LAX since that time, evaluates the effectiveness of adding security film to the windows, and makes recommendations for implementing key findings from Stevens et al. (2004).

REVIEW OF THE 2004 FINDINGS

Terrorism has long been a serious problem for the air transportation system of the United States and other nations. Over 5,000 deaths have resulted from terrorist attacks on civil aviation since 1980; about 200 deaths occurred in attacks on airports themselves, as opposed to aircraft.[1]

LAX has historically been a leader in implementing new security measures. It was one of the first major airports to implement a 100 percent baggage-screening program and to have an on-site bomb squad, a high police presence, a distributed terminal layout, and a large number of explosive-detection dogs. Despite this level of security, there are good reasons to believe that LAX is viewed by some terrorist organizations as an attractive target. Since 1974, LAX has been the target of two bombings, two attempted bombings, and one handgun attack. LAX is also the fifth busiest passenger airport and sixth busiest cargo airport in the world. LAX also fits terrorist organizations' criteria for economically sensitive targets—according to LAWA, LAX provides the Southern California economy with over $70 billion in revenue each year.

[1] See the MIPT Terrorism Knowledge Base, online at http://www.tkb.org.

The fundamental problem with terrorism is how to influence most effectively the behavior of an unpredictable enemy through an appropriate combination of prevention, protection, and response capabilities that will have a deterrent effect on those adversaries. The logical structure of the problem is similar to the problem of preventing nuclear war, which RAND has studied extensively over many years. The solution is to shape the situation so that in any scenario the outcomes from the adversary's point of view will be unsatisfactory. This will help to achieve the primary goal of deterrence. Terrorists will look at the airport and decide that attacking it isn't worth the operational costs and risks or will not achieve a desired outcome.

Operationally, the key to implementing a successful strategy of deterrence is to understand and reduce LAX's vulnerabilities and to minimize the potential consequences of an attack. In Stevens et al. (2004), we analyzed a wide range of possible terrorist actions and assessed LAX's level of vulnerability. We then examined possible alternative courses of action LAX could take to reduce these vulnerabilities and mitigate potential consequences.

Terrorist Attack Scenarios

We identified 11 major classes of attack. These are not the only possible attacks, but they are the ones that we assess to be most likely and most difficult to prevent. Some of the specifics of these scenarios have been removed at the request of the Transportation Security Administration (TSA). Starting with the likely scenarios most threatening to LAX with its current security procedures, the threats are as follows:

Insider-Planted Bomb. A bomb could be placed, with the assistance of an employee with access to the airport, inside a large passenger aircraft, causing it to be destroyed in flight, potentially killing hundreds of passengers. Such a bomb would require between 3 and 20 pounds of explosive, depending on where it is placed.

Cargo Bomb. A bomb is placed inside cargo that is loaded onto a passenger aircraft, causing it to be destroyed in flight, potentially killing hundreds of passengers. Like the bomb planted by an insider, it would require between 3 and 20 pounds of explosives, depending on where the cargo is placed.

Large Truck Bomb. A bomb in the 1,000–4,000 pound range could be concealed in a truck. If detonated at the lower level, we expect a large number of deaths and severe damage to both the arrival and departure levels of the terminal, along with two sections of elevated roadway.

Luggage Bomb. A 50-pound bomb detonated in a crowded screening line could produce a large number of deaths. The number of deaths in this scenario is very sensitive to the density and number of people standing in line. The luggage bomb is also a good surrogate for a suicide bomber.

Curbside Car Bomb. A 500-pound bomb detonated in the right lane of the roadway in front of the line of people on the sidewalk waiting for a skycap will cause a large number of deaths on the sidewalk and in the terminal. Again, the number of deaths is very sensitive to the density and number of people standing in line.

MANPADS. We assume that a MANPADS (man-portable air defense system, usually shoulder-fired) attack will result in the destruction of an airliner less than 10 percent of the time.

Public Area Attack. A well-armed group of three to ten terrorists with body armor and automatic weapons could kill a large number of people before being stopped. Current airport police capabilities would be of limited effectiveness against well-equipped attackers.

Air Operations Attack. A well-armed group of three to ten terrorists could enter the air operations area by jumping the fence or entering via an unprotected cargo operator. These terrorists could attack parked or taxiing airliners.

Tower/Utility Plant Bombing. We assume that a car or truck bomb with 1,000+ pounds of explosives will result in either the destruction of the tower or the destruction of a significant portion of the utility plant.

Sniper. In one possible scenario, a sniper who sets up on airport-adjacent property with a .50-caliber sniper rifle would shoot at loaded planes, firing approximately 50 shots over five minutes.

Mortar Attack. In an Irish Republican Army mortar attack on London's Heathrow airport (March 1995), attackers disrupted airport operations for several days. This type of attack at LAX would kill few people on average, but it is possible, albeit unlikely, that a mortar round could hit a loaded plane.

Security Improvement Options

In 2004, we evaluated a series of possible security improvement options that could reduce the potential consequences described in the foregoing threat scenarios. Different security improvement options will have different consequences depending on the threat scenario. We focused on security options that offered the greatest effectiveness against the most-

threatening attacks. We then estimated the costs, both initial and recurring, for each security improvement option.

We found that the security improvement options fell into four broad categories.

1. Low-cost options that greatly reduce the risk of terrorism at LAX. These options should be acted upon immediately.
2. High-cost options that greatly reduce the risk of terrorism at LAX.
3. Low-cost options that modestly reduce the risk of terrorism at LAX.
4. Expensive solutions to modest problems. We did not recommend implementing these solutions.

We suggested that two options in category 1 should be implemented immediately: reducing the density of people in unsecured areas, and adding permanent vehicle security checkpoints with bomb-detection capabilities.

Reducing the Density of People in Unsecured Areas (Areas in Which Baggage Has Not Been Inspected or Areas Near Uninspected Vehicles). Eliminating lines at baggage check-in is very effective because the existing lines create an attractive target where a terrorist could bring a substantial bomb concealed in luggage with little risk of arousing suspicion. Similarly, lines outside terminals are attractive targets for vehicle bombs. Reducing the density of people in terminals is also effective against suicide bombers and other attacks in the terminals (the most significant recent event at an LAX terminal was perpetrated with a handgun).

It is perhaps surprising that the costs of eliminating check-in lines is quite modest, according to our assessments. Overall airport efficiency, including the operations of LAWA, airlines, and the TSA is not significantly enhanced by having people stand in line. The amount of actual work required to check bags and related activities remains the same whether people have waited or not. Substantial reduction of lines can be implemented immediately with small changes to airline and TSA staffing policies. Having two additional people checking in bags during rush periods would dramatically reduce the lines. This was our strongest recommendation.

Adding Permanent Vehicle Security Checkpoints with Bomb-Detection Capabilities. Large vehicle bombs can be effectively detected by quick examination of vehicles entering the airport by well-trained personnel. Improved technology is becoming available, but even simple vehicle scales can identify suspicious vehicles, which can then be diverted before

entering the airport proper. This will greatly reduce the threat from large vehicle bombs and provide some effectiveness against smaller bombs. It will not likely be effective against small bombs concealed in luggage. Detecting smaller luggage bombs would require a detailed search, which currently would be very expensive. We do not see improved efficiencies in technologies for screening automobiles to the point that every car could be screened for small packages.

WHAT HAS CHANGED SINCE 2004?

Several things have changed at LAX since we made those recommendations for security enhancement.

The airport's long-range plan is being completely reevaluated and studied. In 2004, the long-range plan (Alternative D) called for the airport terminals to be torn down in ten years and replaced by new terminals where the central parking structures currently exist. Because terminals will now not be replaced under Alternative D, enhancements to the terminals will have more than the ten-year life span that was expected in 2004.

There has been an increase in the physical space allocated to TSA operations in the terminals, which has allowed TSA to operate more efficiently. TSA has added screening lines in most of the crowded terminals. TSA is also now hiring part-time staff that can be brought in during peak periods.

Perhaps the biggest change is the large increase in the number of automated check-in facilities that allow passengers to check in luggage and receive boarding passes more efficiently. (An in-depth analysis of this change will be available in a forthcoming document.) This increase in efficiency has resulted in a slight reduction in the lines inside the terminals and a reduction in airline staffing in the terminals.

Two years ago, LAWA commissioned several in-depth studies of options for reducing the crowds in terminals and installing permanent vehicle checkpoints. These studies validated much of the analysis from Stevens et al. (2004).

Lastly, in November 2005, LAWA asked RAND to analyze the blast effects on the windows at LAX and evaluate installation of security film on windows facing the public roadway.

WHAT HAS NOT CHANGED SINCE 2004?

Overcrowded Terminals at LAX

The crowded public areas at LAX continue to be an attractive target for terrorist bombs. Large bombs, in excess of 500 pounds, can be detected by vehicle checkpoints at the entrances to LAX. It is currently nearly impossible for vehicle checkpoints to find luggage bombs or suicide bombers. The only cost-effective solution to these bomb threats is to reduce the level of risk by reducing the density of people at various high-traffic points in the terminals.

The overcrowding of the terminals could be easily mitigated. Most of the people in the terminals are waiting in line; others appear to be lost or confused about what to do next. Modest increases in capacity to check people in through more-efficient systems or increases in staffing at security checkpoints could dramatically reduce the number of people waiting in line.

In our 2004 study, we estimated that the total cost of eliminating the crowding in terminals would be approximately $4 million per year. In 2005, at LAWA's request, Leigh Fisher Associates reviewed this issue. Our findings were that a 5 percent increase in staffing would decrease the waiting time in lines by 75 percent—with a commensurate decrease in the number of people in line. Leigh Fisher Associates assessed that it would require a 15 percent increase in staffing to reduce the lines by 75 percent. Leigh Fisher Associates did not conduct a comprehensive risk assessment but concluded that a 75 percent decrease in lines was not worth implementing. Our assessment concluded that a 75 percent decrease in lines would substantially decrease vulnerability to luggage bombs and suicide bombers.

We continue to work with LAWA, the Los Angeles Airlines Airport Affairs Committee, and the airlines to understand the crowding issues particular to each terminal. We are also working with LAWA to develop a plan to motivate the airlines to help reduce the crowding in terminals.

Vehicle Checkpoints at LAX

Vehicles can enter LAX through six unsecured locations. Currently there are no checkpoints at LAX to examine incoming vehicles for bombs. Any vehicle could enter the CTA with a large bomb.

In Stevens et al. (2004), we found that for a cost of about $5 million to $7 million of capital expense, LAX could add permanent vehicle checkpoints

without reducing the total number of traffic lanes entering the airport. We found this to be the most cost-effective solution to car and truck bombs.

In December 2004, LAWA completed an in-depth study of adding and staffing permanent vehicle checkpoints. Although their infrastructure costs were about the same as ours, they assumed much higher staffing costs. The LAWA analysis assumed that checkpoints would be staffed 24 hours a day, seven days a week and that every car would be stopped for 5, 15, or 30 seconds. LAWA concluded that the congestion caused by the checkpoints was too disruptive and the staffing costs too high to provide round-the-clock inspections of every vehicle.

We have three recommendations for going forward with permanent vehicle checkpoints. First, we need to revalidate the threat. RAND and LAWA will work with the newly created Airport Security Advisory Committee to determine if car and truck bombs are still a threat to LAX. Second, we will work with LAWA to determine if an effective solution exists for the staffing costs. Finally, we recommend that LAWA work with TSA to develop a testing program for fielding bomb-detection equipment at vehicle checkpoints.

VALUE OF ADDING SECURITY FILM TO WINDOWS

One security option that has been suggested is the addition of security film to the windows facing the public roadways. Security film is a polyester film usually between four millimeters and 15 millimeters thick. It is applied to the interior surface of the glass using a pressure-sensitive acrylic adhesive. It is intended to lessen the harmful consequences of the glass breaking. It is widely used on annealed glass that has not been treated for bomb blasts. It is not widely used on tempered or laminated glass.

LAX is vulnerable to car bomb explosions in the CTA. If a 1,000-pound car bomb were detonated in front of a terminal, there would be a large number of deaths inside the terminal from structural failure and falling debris. Glass would break throughout the CTA.

Three types of glass are used in windows. Annealed glass is the most common glass. Present in high-rise construction, it is not treated to make it safer against bomb blasts. LAX does not have any annealed glass in its terminals. Tempered glass has been heat-treated to shatter into small nuggets. The side windows in automobiles are tempered glass. LAX has about 120,000 square feet of tempered glass for the windows on the terminals facing the CTA. Laminated glass has layers of strengthening

film in between sheets of glass. Tom Bradley International Terminal has about 20,000 square feet of laminated glass facing the CTA.

Although a car bomb would cause glass to break throughout the CTA, the broken glass would not cause many deaths or serious injuries. Only tempered glass within 80 feet of the bomb would be accelerated to a speed that would be lethal. Most people within 80 feet of the bomb would be killed by structural collapse and flying debris. Fatalities would occur from flying debris out to 500 feet from the bomb. Most people who could be killed by flying glass would likely already be dead from the structural collapse and flying debris.

This finding is substantiated by examining the trauma reports from the bombings at Khobar Towers in Saudi Arabia in 1998, the Murrah Federal Building in Oklahoma City in 1995, and in London in 1993. Only one death from all of these attacks could be attributed to accelerated tempered glass, and that one was from Khobar Towers.

One problem with security film is that it has to be properly anchored to the window frame. If the film is not properly anchored, a car bomb could cause the window to adhere to the film but come loose from the frame, flying as one large piece into the terminal and causing serious injuries—for tempered glass, this is worse than having no film because tempered glass breaks into small nuggets. LAX currently has very large windows facing the CTA. To properly anchor the film on these windows would require an anchoring system well in excess of what is available today. The examples we found of windows that had been covered with security film were all much smaller than the windows at LAX.

There are very few examples of commercial buildings where security film has been added to their tempered glass. (There are plenty of examples of adding security film to annealed glass.) Most of the buildings that have added security film to larger panes of glass have also added a system (like a chain mesh) to catch the glass should the anchoring be insufficient.

The laminated glass at Tom Bradley International Terminal is not a safety problem because the terminal is set back more than 80 feet from the curb, making it less vulnerable to car bombs. Also, the terminal's windows are smaller than other LAX windows and the strengthening film has already been sufficiently anchored.

CONCLUSIONS AND RECOMMENDATIONS

In Stevens et al. (2004), we found that the key to a successful strategy of deterrence against an unpredictable enemy is to understand and reduce

LAX's vulnerabilities and the potential consequences of an attack, making it a less attractive target. The airport is vulnerable in a number of ways but particularly to large truck bombs, luggage bombs, and curbside car bombs. Two steps, relatively easy and cost-effective to implement, could mitigate the risks from all three of these threats.

1. Reduce the probability of the success of the bombers by adding permanent vehicle checkpoints at the entrances to LAX.
2. Reduce potential consequences at LAX by reducing crowds on the sidewalks and inside terminals.

One reason that reducing the crowds at the terminals is more cost-effective than adding security film to the glass is that reducing the crowds mitigates the potential consequences from car bombs, luggage bombs, and suicide bombers, while applying film to the glass is only effective (if properly applied) against car bombs. We stand by our 2004 conclusions.