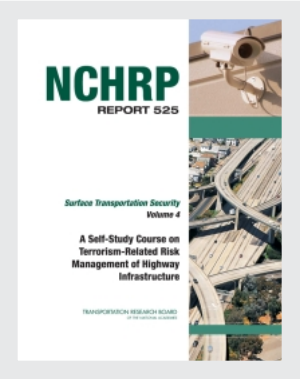

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NCHRP REPORT 525

Surface Transportation Security

Volume 4

A Self-Study Course on Terrorism-Related Risk Management of Highway Infrastructure

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION (SAIC)
TRANSPORTATION DIVISION
McLean, VA

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NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

Systematic, well-designed research provides the most effective approach to the solution of many problems facing highway administrators and engineers. Often, highway problems are of local interest and can best be studied by highway departments individually or in cooperation with their state universities and others. However, the accelerating growth of highway transportation develops increasingly complex problems of wide interest to highway authorities. These problems are best studied through a coordinated program of cooperative research.

In recognition of these needs, the highway administrators of the American Association of State Highway and Transportation Officials initiated in 1962 an objective national highway research program employing modern scientific techniques. This program is supported on a continuing basis by funds from participating member states of the Association and it receives the full cooperation and support of the Federal Highway Administration, United States Department of Transportation.

The Transportation Research Board of the National Academies was requested by the Association to administer the research program because of the Board's recognized objectivity and understanding of modern research practices. The Board is uniquely suited for this purpose as it maintains an extensive committee structure from which authorities on any highway transportation subject may be drawn; it possesses avenues of communications and cooperation with federal, state and local governmental agencies, universities, and industry; its relationship to the National Research Council is an insurance of objectivity; it maintains a full-time research correlation staff of specialists in highway transportation matters to bring the findings of research directly to those who are in a position to use them.

The program is developed on the basis of research needs identified by chief administrators of the highway and transportation departments and by committees of AASHTO. Each year, specific areas of research needs to be included in the program are proposed to the National Research Council and the Board by the American Association of State Highway and Transportation Officials. Research projects to fulfill these needs are defined by the Board, and qualified research agencies are selected from those that have submitted proposals. Administration and surveillance of research contracts are the responsibilities of the National Research Council and the Transportation Research Board.

The needs for highway research are many, and the National Cooperative Highway Research Program can make significant contributions to the solution of highway transportation problems of mutual concern to many responsible groups. The program, however, is intended to complement rather than to substitute for or duplicate other highway research programs.

Note: The Transportation Research Board of the National Academies, the National Research Council, the Federal Highway Administration, the American Association of State Highway and Transportation Officials, and the individual states participating in the National Cooperative Highway Research Program do not endorse products or manufacturers. Trade or manufacturers' names appear herein solely because they are considered essential to the object of this report.

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NOTICE

The project that is the subject of this report was a part of the National Cooperative Highway Research Program conducted by the Transportation Research Board with the approval of the Governing Board of the National Research Council. Such approval reflects the Governing Board's judgment that the program concerned is of national importance and appropriate with respect to both the purposes and resources of the National Research Council.

The members of the technical committee selected to monitor this project and to review this report were chosen for recognized scholarly competence and with due consideration for the balance of disciplines appropriate to the project. The opinions and conclusions expressed or implied are those of the research agency that performed the research, and, while they have been accepted as appropriate by the technical committee, they are not necessarily those of the Transportation Research Board, the National Research Council, the American Association of State Highway and Transportation Officials, or the Federal Highway Administration, U.S. Department of Transportation.

Each report is reviewed and accepted for publication by the technical committee according to procedures established and monitored by the Transportation Research Board Executive Committee and the Governing Board of the National Research Council.

To save time and money in disseminating the research findings, the report is essentially the original text as submitted by the research agency. This report has not been edited by TRB.

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Advisers to the Nation on Science, Engineering, and Medicine

The **National Academy of Sciences** is a private, nonprofit, self-perpetuating society of distinguished scholars engaged in scientific and engineering research, dedicated to the furtherance of science and technology and to their use for the general welfare. On the authority of the charter granted to it by the Congress in 1863, the Academy has a mandate that requires it to advise the federal government on scientific and technical matters. Dr. Bruce M. Alberts is president of the National Academy of Sciences.

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The **Transportation Research Board** is a division of the National Research Council, which serves the National Academy of Sciences and the National Academy of Engineering. The Board's mission is to promote innovation and progress in transportation through research. In an objective and interdisciplinary setting, the Board facilitates the sharing of information on transportation practice and policy by researchers and practitioners; stimulates research and offers research management services that promote technical excellence; provides expert advice on transportation policy and programs; and disseminates research results broadly and encourages their implementation. The Board's varied activities annually engage more than 5,000 engineers, scientists, and other transportation researchers and practitioners from the public and private sectors and academia, all of whom contribute their expertise in the public interest. The program is supported by state transportation departments, federal agencies including the component administrations of the U.S. Department of Transportation, and other organizations and individuals interested in the development of transportation. **www.TRB.org**

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AUTHOR ACKNOWLEDGMENTS

This self-study course book on risk management—focusing on terrorism-related vulnerability assessment of bridges, tunnels, and other highway infrastructure—is the result of contributions from a number of individuals, state highway departments of transportation (DOTs), and federal agencies. The National Cooperative Highway Research Program (NCHRP) of the Transportation Research Board (TRB) funded the development of the original workshops and this book on behalf of the American Association of State Highway and Transportation Officials (AASHTO) Transportation Security Task Force. The Federal Highway Administration (FHWA) served as the primary advisor for this course book.

The information contained in this self-study course book is derived from the contents of three national workshops conducted under NCHRP Project 20-59(02) in 2003. These workshops for multiple state DOTs were hosted by three state DOTs—the Texas Department of Transportation (Texas DOT), the California Department of Transportation (Caltrans), and the New York State Department of Transportation (NYSDOT). The lead state DOT sponsors of the workshops were the state bridge engineers: Mary Lou Ralls (Texas DOT), Richard Land (Caltrans), and George Christian (NYSDOT).

The content of this self-study course reflects the best judgment and experience of Science Applications International Corporation (SAIC) and PB Consult, which developed and compiled the course material and presented the material in the workshops. The principal investigator of the project was Dr. Shahed Rowshan. The other primary authors were Dr. Michael Smith (SAIC) and Stephen Lockwood (PB Consult). The contents of this study do not represent an official view of any sponsor, highway administration, or federal agency.

FOREWORD

By S. A. Parker
Staff Officer
Transportation Research Board

This fourth volume of *NCHRP Report 525: Surface Transportation Security* will be of interest to state DOT and highway authorities with responsibility for state-level program planning and policy, asset (e.g., bridge and tunnel) management, and security. The law-enforcement community and emergency responders are essential in risk-management planning and should be familiar with the concepts in this course. In federal agencies, security decision makers, field office representatives, and bridge and tunnel engineers could benefit from this course. In general, engineers, planners, and researchers involved in security assessment and planning would find the concepts in this course beneficial.

The AASHTO Transportation Security Task Force, in cooperation with FHWA and the Transportation Research Board (TRB), sponsored the NCHRP 20-59(02) project to provide three national workshops to familiarize transportation agencies and other interested parties with the AASHTO methodology published in the *Guide to Highway Vulnerability Assessment for Critical Asset Identification and Protection*. Three state DOTs—California, New York, and Texas—hosted national workshops that were conducted in spring 2003.

The objectives of *Volume 4: A Self-Study Course on Terrorism-Related Risk Management of Highway Infrastructure* are (1) to provide a general background in terrorism-related risk management for highway infrastructure and (2) to assist bridge and structures engineers and managers in

- Identifying critical highway assets and their potential vulnerabilities,
- Developing possible countermeasures to prevent or ameliorate threats to such assets, and
- Determining the capital and operating costs of such countermeasures.

This volume of *NCHRP Report 525* was prepared under NCHRP Project 20-59(02) by Science Applications International Corporation with PB Consult; the report is presented in PowerPoint and portable document format (pdf) on *CRP-CD-55*.

Emergencies arising from terrorist threats highlight the need for transportation managers to minimize the vulnerability of travelers, employees, and physical assets through incident prevention (including deterrence), response preparedness, consequence mitigation, effective response, and rapid recovery. Managers seek to reduce the chances that transportation vehicles and facilities will be targets or instruments of terrorist attacks and to be prepared to respond to and recover from such possibilities. By being prepared to respond to terrorism, each transportation agency is simultaneously prepared to respond to natural disasters such as hurricanes, floods, and wildfires, as well as human-caused events such as hazardous materials spills and other incidents.

This is the fourth volume of *NCHRP Report 525: Surface Transportation Security*, a series in which relevant information is assembled into single, concise volumes—each

pertaining to a specific security problem and closely related issues. These volumes focus on the concerns that transportation agencies are addressing when developing programs in response to the terrorist attacks of September 11, 2001, and the anthrax attacks that followed. Future volumes of the report will be issued as they are completed.

To develop this volume in a comprehensive manner and to ensure inclusion of significant knowledge, available information was assembled from numerous sources, including a number of state departments of transportation. A panel of topic experts in the subject area was established to guide the researchers in organizing and evaluating the collected data and to review the final document.

This volume was prepared to meet an urgent need for information in this area. It records practices that were acceptable within the limitations of the knowledge available at the time of its preparation. Work in this area is proceeding swiftly, and readers are encouraged to be on the lookout for the most up-to-date information.

Volumes issued under *NCHRP Report 525: Surface Transportation Security* may be found on the TRB website at http://www4.trb.org/trb/crp.nsf/All+Projects/NCHRP+20-59.

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Abbreviations used without definitions in TRB publications:

AASHO	American Association of State Highway Officials
AASHTO	American Association of State Highway and Transportation Officials
APTA	American Public Transportation Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATA	American Trucking Associations
CTAA	Community Transportation Association of America
CTBSSP	Commercial Truck and Bus Safety Synthesis Program
DHS	Department of Homeland Security
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
IEEE	Institute of Electrical and Electronics Engineers
ITE	Institute of Transportation Engineers
NCHRP	National Cooperative Highway Research Program
NCTRP	National Cooperative Transit Research and Development Program
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
SAE	Society of Automotive Engineers
TCRP	Transit Cooperative Research Program
TRB	Transportation Research Board
TSA	Transportation Security Administration
U.S.DOT	United States Department of Transportation