

Contents

Contents		Page
Chapter 1. Summary	...	1
INTRODUCTION	...	1
PRINCIPAL FINDINGS	...	4
Finding 1	...	4
Finding 2	...	5
Finding 3	...	7
Finding 4	...	8
Finding 5	...	10
STATE OF EXPLOSIVES DETECTOR DEVELOPMENT	...	11
Chapter 2. Introduction	...	13
THE ROLE OF TECHNOLOGY IN COUNTERING TERRORISM	...	13
OUTLINE OF THIS STUDY	...	13
Chapter 3. The Terrorist Threat	...	15
INTRODUCTION	...	15
A DEFINITIONAL FOCUS	...	15
TERRORISM: PAST, PRESENT, AND FUTURE	...	17
Historical Origins	...	17
Contemporary Terrorism	...	17
Two Decades of Terrorism: A Statistical Overview	...	19
Terrorism in the Future	...	19
THE THREAT TO THE UNITED STATES	...	23
Domestic Terrorism	...	23
International Terrorism	...	24
OBSERVATIONS AND CONCLUSIONS	...	28
Chapter 4. Research and Development	...	31
INTRODUCTION	...	31
Explosives Detection	...	31
Chemical and Biological Agents	...	32
Physical Protection	...	32
Incident Response	...	33
Data Dissemination	...	33
DETECTING EXPLOSIVES	...	33
Introduction	...	33
The Explosive Threat	...	34
History	...	35
Methods of Explosives Detection	...	38
Accelerator Technology	...	45
X-Ray Technologies	...	46
DEFENSE AGAINST CHEMICAL AND BIOLOGICAL WARFARE (CBW) AGENTS	...	51
Chemical and Biological Agents—Point and Remote Detection	...	52
PHYSICAL PROTECTION	...	54
Detectors and Alarms	...	55
Barriers	...	55
Building Hardening	...	56
Aircraft Hardening	...	56
Access Control	...	56
Baltimore-Washington International (BWI) Airport Project	...	57
INCIDENT RESPONSE	...	58
DATA DISSEMINATION	...	59

Chapter 5. Conclusions Regarding Current Research and Development Into	
Detection of Explosives	61
TESTING AND EVALUATION	62
MANAGING RESEARCH	63
Cooperation	63
Time From Laboratory To Deployment..	63
FAA RULEMAKING FOR EXPLOSIVES DETECTION SYSTEMS	64
Appendix A. Nuclear-based Explosives Detection Systems	67
Appendix B. X-Ray-Based Detection Systems	78
Appendix C. Vapor Detection Systems	81
Appendix D. Chemical and Biological Warfare Agent Detection	87
Appendix E. Recent Federal Counterterrorism Research Efforts: Agencies and Their Budgets . . .	91
Appendix F. Congressional Request and Support Letters	100

Figures

<i>Figure</i>	<i>Page</i>
3-1. Distribution of Categories of International Terrorist Attacks 1970-79 and 1980-89	20
3-2. Geographical Distribution of Terrorist Attacks Against U.S. Citizens and Interests, 1970-79	26
3-3. Geographical Distribution of Terrorist Attacks Against U.S. Citizens and Interests, 1980-89	27
4-1. Densities of Various Materials	41
4-2. Nitrogen Percentage of Various Materials	42
4-3. Nitrogen Density of Various Materials	43
4-4. Correlation Between Oxygen and Nitrogen Densities in Explosives and Other Materials	44
4-5. Relative Volatilities of Some Common Explosives	48
5-1. Advantages and Disadvantages of Available (or nearly available) Explosives	
Detection Techniques	62
A-1. Sketch of Apparatus for Thermal Neutron Analysis of Nitrogen	68
A-2. Sketch of Apparatus for Fast Neutron Analysis of Nitrogen, Carbon, and Oxygen	71
A-3. Sketch of Apparatus for Pulsed Neutron Beam Analysis	72
A-4. Resonant Absorption of Gamma Rays	74
A-5. Resonant Absorption of Gamma Rays	75

Tables

<i>Table</i>	<i>Page</i>
1-1. FY 1990 Levels of Federal Funding in Research and Development Specifically	
Directed at Counterterrorism	6
3-1. Regional Distribution of Attacks Against U.S. Citizens and Interests 1970-89	25
4-1. Some Common Explosives	36
4-2. Explosives Detection Technologies	39
4-3. Airline Crashes Caused by Terrorist Bombs, 1982-89	40
4-4. Chemical and Biological Agent Detection Goals	53
5-1. Advantages and Disadvantages of Available (or nearly available) Explosives	
Detection Techniques	62
E-1. Federal Agencies Engaged in Counterterrorism Research	92
E-2. Allocation of FAA Security R&D Resources	98
E-3. Allocation of FAA Fiscal Year 1990 Contract Dollars for Major Program Priorities.	98