Appendix 14A. Global efforts to control MANPADS

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I. Introduction

Preventing the acquisition and use of man-portable air defence systems (MANPADS) by terrorists and rebel groups has been a matter of concern since the early 1970s. However, despite the persistence of the threat MANPADS pose to aviation, it was the 2002 al-Qaeda attack on an Israeli civilian aircraft flying out of Mombassa, Kenya, that focused world attention on the issue.

This introductory section continues by providing some basic information on the development and main types of MANPADS and their capabilities. Section II of this appendix gives an overview of the main threats posed by the weapon. Section III reviews efforts to control the weapon prior to the Mombassa attack, and section IV examines contemporary counter-MANPADS efforts. Section V presents some concluding observations and recommendations for further action.

MANPADS fire short-range surface-to-air (SAM) missiles and are designed to be carried and operated by a single individual or a crew of several individuals. There are three basic types of missile used by MANPADS, which are often categorized by their guidance system: passive infrared seekers, laser-beam riders and command line-of-sight (CLOS) system (see table 14A). Most MANPADS missiles, including the Soviet/Russian SA series, the US Stinger and the Chinese Vanguard, are lightweight, 'fire-and-forget' missiles that home in on infrared light generated by heat from the target aircraft. Since the unveiling of the relatively primitive US FIM-43 Redeye and the Soviet SA-7 (Strela 2)[1] in the 1960s, weapons designers have steadily improved the range, altitude and guidance of infrared seekers. The latest version of the Stinger, for example, has a maximum range and altitude that are 2195 metres and 1585 metres longer, respectively, than the Redeye and an improved seeker that gives the missile an 'all aspect engagement capability'. It can hit a target from any direction (front, rear and side) and discriminate between aircraft and other heat sources, including protective flares.[2] The portability, ease of use and accuracy of infrared seekers have made them the most popular and the most widely proliferated type of MANPADS.

[1] The North Atlantic Treaty Organization and the USA use their own reporting names when referring to Russian or Soviet military equipment. E.g. 'SA-7' is the US designation for the Russian Strela missile. US designations are principally used in this appendix.

[2] Lyons, L., Long, D. and Chait, R., *Critical Technology Events in the Development of the Stinger and Javelin Missile Systems: Project Hindsight Revisited* (National Defense University: Washington, DC, July 2006), URL <http://www.ndu.edu/ctnsp/Defense_Tech_Papers.htm>, p. 10; Redstone Arsenal, 'Stinger avenger', URL <http://www.redstone.army.mil/history/systems/STINGER.html>; and Schaffer, M., *The Air Force Role in Reducing the Missile Threat to Civil Aviation* (RAND Corporation: Santa Monica, Calif., 2002).

Table 14A.1. MANPADS-producing countries and basic weapon specifications

				Derivatives, copies and licensed production	
Country	Designation	Guidance system	Range (m)[a]	Country	Designation
China	HN-5[b]	IR homing	4 400	Pakistan	Anza
				N. Korea	. .
	QW-1/Vanguard	IR homing	5 000	Pakistan	Anza-2
				Iran	Misagh-1
	QW-2	IR homing	6 000		
	FN-6	IR homing	5 500		
France	Mistral	IR homing	6 000		
Japan	Type-91 Kin-sam	IR homing	5 000		
Poland	Grom-2	IR homing	5 200		
S. Korea	Chiron	IR homing	7 000		
Russia/ CIS	SA-7 (Strela-2)	IR homing	4 400	China	HN-5
				Egypt	Ayn-al-Saqr
				Romania	CA-94M
				Serbia	. .
	SA-14 (Strela-3)	IR homing	5 500	Bulgaria	. .
				N. Korea	. .
	SA-18 (Igla)	IR homing	5 200		
	SA-16 (Igla-1)	IR homing	5 200	Bulgaria	. .
				N. Korea	. .
				Poland	Grom-1
				Singapore	. .
				Viet Nam	. .
Sweden	RBS-70	Laser-beam riding	7 000	Pakistan	RBS-70
	Bolide	Laser-beam riding	8 000		
UK	Blowpipe	Command line of sight	4 000		
	Javelin	Command line of sight	5 500		
	Starburst	Laser-beam riding	6 000		
	Starstreak	Laser-beam riding	7 000		
USA	FIM-43 Redeye	IR homing	4 500		
	FIM-92 Stinger	IR/UV homing	8 000	Europe	Fliegerfaust-2
				Switzerland	. .
				N. Korea	Illegal copy

IR = Infra-red homing; UV = ultra violet; CIS = Commonwealth of Independent States;

[a] The range given is the maximum range. The effective range may be less.

[b] The Chinese HN-5 is a copy of the Soviet SA-7.

Sources: Small Arms Survey; and Foss, C. F. and O'Halloran, J. C. (eds), *Jane's Land-Based Air Defence 2006–2007* (Jane's Information Group: Coulsdon, 2006).

Laser-beam-riding missiles, the most common of which is the Swedish RBS-70, follow a laser beam projected onto the target by the operator. The system, which consists of a stand, a sight and a missile, is bulkier and more difficult to use than its infrared-seeking counterparts (which can generally be fired from the shoulder) but, in the hands of a skilled operator, is also more lethal. The new Swedish Bolide missile has a maximum range of 8000 m and a laser guidance system allowing the missile to

be directed towards the most vulnerable part of an aircraft, increasing the probability of destroying the target to over 90 per cent in head-on engagements.[3] The RBS-70 is also impervious to aircraft-mounted anti-missile systems, making it a particularly worrisome threat in the hands of terrorists and insurgents. As of 2006, at least 20 countries have produced or imported laser-beam riding missiles, the vast majority of which are RBS-70 systems.[4] CLOS systems use radio-controlled missiles. The United Kingdom produced the only CLOS systems—the Javelin and the Blowpipe—neither of which is still in production.[5] In total, an estimated 1 million missiles for MANPADS have been produced, and it is estimated that 500 000–750 000 remain in the global inventory.[6]

II. Threats

Acquisition of MANPADS by non-state actors

Since the early 1970s terrorist and insurgent groups have acquired MANPADS from a variety of sources, including state sponsors, private arms dealers, poorly secured weapon depots, and other terrorists and insurgents. These missiles have been used to shoot down hundreds of military aircraft and dozens of civil aircraft.

While data on the acquisition of MANPADS by terrorists and insurgents are patchy, open-source literature suggests that, historically, transfers from governments to non-state actors have been a major, if not the largest, source of MANPADS for these groups. The Soviet Union provided its first-generation SA-7 missiles to North Viet Nam, who used them against US and South Vietnamese aircraft during the 1959–75 Viet-Nam War. In Afghanistan in the 1980s the USA shipped hundreds of US Stingers, British Blowpipes and even the Soviet Union's own SA series (which the Central Intelligence Agency, CIA, reportedly obtained from a corrupt Polish general)[7] to anti-Soviet rebels. By the time Soviet forces left Afghanistan in 1989, the Stinger missiles alone were credited with having downed nearly 270 Soviet planes and helicopters.[8]

Several former Soviet client states have also provided MANPADS to non-state actors. In the 1970s and 1980s, Libyan leader Muammar Qadhafi supplied his missiles to the Popular Front for the Liberation of Palestine (PFLP) and the Provisional Irish Republican Army (IRA). State-sanctioned shipments of MANPADS to non-state actors dropped off precipitously after the cold war, but did not end entirely. In 1998 Eritrea was accused of providing more than 40 SA-series missiles to the Somalian warlord Hussein Aideed, who was sheltering an Eritrean-backed Ethiopian

[3] See Saab Group, 'RBS 70', URL <http://www.saabgroup.com/en/capabilities>.

[4] Foss, C. F. and O'Halloran, J. C. (eds), *Jane's Land-Based Air Defence 2006–2007* (Jane's Information Group: Coulsdon, 2006).

[5] Foss and O'Halloran (note 4).

[6] Government Accountability Office (GAO), *Further Improvements Needed in US Efforts to Counter Threat from Man-Portable Air Defense Systems*, GAO-04-519 (GAO: Washington, DC, May 2004), URL <http://www.gao.gov/docdblite/details.php?rptno=GAO-04-519>, p. 10.

[7] Crile, G., *Charlie Wilson's War* (Grove Press: New York, N.Y., 2003), p. 159.

[8] Kuperman, A. J., 'The Stinger missile and US intervention in Afghanistan', *Political Science Quarterly*, vol. 114, no. 2 (summer 1999), pp. 219–63.

rebel group at the time.[9] More recently, United Nations investigators and Western intelligence officials have accused Iran of providing dozens of MANPADS to the Islamic Courts Union—an umbrella group of Islamic Somali militias—and of conspiring to supply advanced Russian-produced SAM systems to Hezbollah to transform the group 'into a coherent fighting force and a regional strategic arm'.[10]

The insidious combination of rogue arms brokers and weak national export controls is another cause of the proliferation of MANPADS to non-state actors. In May 2000, arms traffickers with ties to the Russian broker Viktor Bout reportedly delivered SA-series missiles to Liberia, which was under a UN arms embargo at the time. A few years later, UN investigators spotted what appeared to be nine of the missiles in film footage of Liberian rebels.[11] Similarly, arms traffickers working on behalf of an Angolan rebel group attempted to acquire advanced Igla SA missiles from Russia using false end-user certificates. In this case, however, the Russians suspected foul play and ended negotiations before any missiles were transferred.[12]

Poor stockpile security, battlefield losses, corruption and disorder following regime change also enable terrorists and insurgents to acquire MANPADS. According to Harvard University's Mark Kramer, guerrillas in Russia's restive province of Chechnya acquired Russian MANPADS from 'unguarded warehouses in southern Russia, from stockpiles captured during ambushes . . . from criminal gangs, and from Russian troops who sold them at a discount'.[13] The greatest threat to counter-MANPADS efforts, however, is the sudden collapse of well-armed regimes. In Iraq looters carried off many of the estimated 5000 MANPADS in Iraqi weapon depots after Saddam Hussein's government was overthrown by US troops in March 2003. One year later, US intelligence analysts revised their estimate of black-market MANPADS worldwide to reflect the sudden influx of Iraqi missiles, increasing it threefold to 6000 missiles.[14]

Use of MANPADS by terrorists and other non-state actors

Terrorists and other non-state actors began plotting MANPADS attacks almost immediately after the weapon was initially deployed in the late 1960s. In 1973 the first attack by non-state actors on a commercial airliner, which was reportedly organized by the PFLP and involved Libyan missiles, was narrowly averted when Italian authorities raided an apartment near Rome's Fiumicino airport. On the balcony,

[9] UN Security Council, Report of the Panel of Experts on Somalia pursuant to Security Council Resolution 1474, UN document S/2003/1035, 4 Nov. 2003. Most official UN documents are available at URL <http://documents.un.org/>.

[10] Hughes, R., 'Iran answers Hizbullah call for SAM systems', *Jane's Defense Weekly*, 9 Aug. 2006, URL <http://www.janes.com/defence/news/jdw/jdw060807_1_n.shtml>; and United Nations Security Council, Report of the Monitoring Group on Somalia pursuant to Security Council Resolution 1676, UN document S/2006/913, Nov. 2006. For more on Hezbollah and MANPADS see chapter 10 in this volume.

[11] See UN Security Council, Report of the Panel of Experts pursuant to Security Council Resolution 1343 (2001), UN document S/2001/1015, Oct. 2001, para. 19 on Liberia; and List of individuals subject to the measures imposed by paragraph 4 of Security Council Resolution 1521 (2003) concerning Liberia, updated 1 Aug. 2006, URL <http://www.un.org/sc/committees/1521/tblist.shtml>.

[12] UN Security Council, Report of the Panel of Experts on Violations of Security Council Sanctions Against UNITA, UN document S/2000/203, 28 Feb. 2000.

[13] Kramer, M., 'The perils of counterinsurgency: Russia's war in Chechnya', *International Security*, vol. 29, no. 3 (winter 2004), pp. 5–63.

[14] Jehl, D. and Sanger, D. E., 'US expands list of lost missiles', *New York Times*, 6 Nov. 2004.

police found two SA-7 missiles 'ready to shoot down an [Israeli] El Al plane after take-off'.[15] Kenyan authorities foiled a similar plot three years later.[16]

The first successful MANPADS attack on a commercial airliner occurred in September 1978 when members of the Patriotic Front, a Soviet-backed guerrilla movement fighting the Rhodesian Government, hit a Vickers Viscount turboprop aircraft owned by Air Rhodesia with an SA-7 missile. The plane crashed in rebel-controlled woodland about 65 kilometres from Kariba airport. Thirty-four of the 52 people on board died in the crash, and rebel gunmen killed 15 of the survivors a few hours later. Six months after the crash, Rhodesian rebels shot down another airliner, killing all 59 people on board and demonstrating to the world that the first attack was not a fluke.

Over the next 20 years, civilian aircraft flying over Afghanistan, Angola, Nicaragua, Sudan and other war zones came under fire from missile-wielding terrorists and rebel groups. Several dozen of these missiles found their targets, resulting in 25 downed aircraft and 600 fatalities.[17] Most notably, a MANPADS attack in April 1994 killed Rwandan President Juvénal Habyarimana and sparked the ethnic violence that led to the Rwandan genocide.[18]

III. Early efforts to control MANPADS

National and, to a lesser extent, international efforts to prevent terrorists from acquiring and using MANPADS date back to the advent of the new weapon. For example, by the 1970s the US Government had established strong export controls on MANPADS and stringent stockpile security requirements. Through diplomatic channels, it also attempted to coax the Soviet Union into exercising greater control over its missiles. The USA had also worked closely with the West German Government to address a potential MANPADS threat to Lufthansa airliners.[19] Until recently, however, such international cooperation was fitful, piecemeal, and often superseded by other foreign policy interests.

Early efforts to control MANPADS fell far short of what was needed for several reasons, primarily related to the cold war. The rift between the East and the West prevented the extensive global cooperation required to put pressure on irresponsible governments, dismantle international trafficking networks and establish global norms. The highly charged, zero-sum view of the conflict also resulted in myopic and contradictory foreign policies, a prime example of which was the USA's massive covert aid programme to the mujahedin in Afghanistan after 1979. Even as the USA was denying Jordanian and Saudi requests for Stingers for fear that the missiles would be diverted to terrorists, the CIA distributed hundreds of Stingers to rebel groups. The

[15] Schroeder, M., Stohl, R. and Smith, D., *The Small Arms Trade: A Beginner's Guide* (Oneworld Publications: Oxford, 2007) p. 64.

[16] Greenway, H. D. S., 'Israel admits 5 held over a year as terrorists', *Washington Post*, 15 Nov. 1977.

[17] US State Department, 'The MANPADS menace: combating the threat to global aviation from man-portable air defense systems', Fact sheet, 20 Sep. 2005, URL <http://www.state.gov/t/pm/rls/fs/53558.htm>.

[18] The origin of the missiles used in the attack is not clear. It is reported that investigators acting on behalf of French judge Jean-Louis Bruguiere were able to trace the serial numbers of the two SA-16 missiles used to a batch sold to Uganda. See Swain, J., 'Riddle of the Rwandan assassins' trail', *Sunday Times*, 4 Apr. 2004.

[19] Schroeder, Stohl and Smith (note 15), pp. 65–66.

CIA exercised little direct control over these groups and, not surprisingly, the missiles spread widely, including to terrorists and state sponsors of terrorism.

It was not until the late 1990s that the first significant multilateral counter-MANPADS efforts got off the ground. Within the European Union (EU), the debate on small arms and light weapons (SALW) led in 1997 to a programme for preventing and combating illicit trafficking in conventional arms, followed by the December 1998 Joint Action on illicit arms trafficking in which MANPADS are treated as a specific element.[20] In the USA, the crash of TWA Flight 800 in July 1996 prompted US President Bill Clinton to establish the Commission on Aviation Security and Terrorism, which as part of its remit explored the threat to commercial aviation posed by MANPADS. The MANPADS threat was a side note in the commission's findings but was enough to prompt the US Department of State to begin negotiating a set of international standards for national controls on MANPADS exports.[21]

The forum favoured by both the USA and European countries for wider co-operation was the Wassenaar Arrangement (WA), the pre-eminent multilateral export control body for conventional armaments.[22] In December 2000 the WA produced the Elements for Export Controls of MANPADS—the first multilateral agreement on MANPADS.[23] This agreement laid out a set of controls and evaluation criteria that, if widely and effectively implemented by WA members (which include over half of the MANPADS-producing states), would help to prevent many of the most blatantly problematic MANPADS exports. The most important of these provisions was the de facto ban on transfers to non-state actors,[24] which have been a significant source of black market MANPADS. The ban is unprecedented and runs counter to the unyielding US opposition to restrictions on small arms transfers to non-state actors in other forums. Other important provisions include those that require exporters to ensure that recipients seek permission before re-exporting the missiles, promptly notify the exporter if the missiles are lost or stolen, and undertake specific physical security and stockpile management practices (PSSM), including physical inventories of all MANPADS and separate storage of missiles and launchers. The Elements also served as a foundation for the more rigorous, and widely adopted, set of controls pursued by the USA two years later.

Complementing the Elements were several regional and global initiatives aimed at stemming the illicit trade in SALW more generally, the most prominent of which was the UN Small Arms Process. Initiated in the mid-1990s, the process culminated in 2001 with the adoption of the Programme of Action to Prevent, Combat and Eradicate the Illicit Trade in Small Arms and Light Weapons in All its Aspects.[25] While not focused on MANPADS per se, the Programme of Action calls for a long list of

[20] European Union, Council Joint Action 1999/34/CFSP, 17 Dec. 1998, URL <http://europa.eu.int/eur-lex/en/archive/>.

[21] Schroeder, Stohl and Smith (note 15), pp. 105–106.

[22] On the Wassenaar Arrangement (WA) and a list of its participants see chapter 15 and the glossary in this volume.

[23] Wassenaar Arrangement, Elements for export controls of man-portable air defence systems (MANPADS), Vienna, Dec. 2003, URL <http://www.wassenaar.org/2003Plenary/MANPADS_2003.htm>. For a description of the negotiations that resulted in the Elements see Schroeder, Stohl and Smith (note 15), pp. 107–108.

[24] Section 2.1 of the Elements limits the export of MANPADS to 'foreign governments or to agents authorized by the government'.

[25] United Nations, Programme of Action to Prevent, Combat and Eradicate the Illicit Trade in Small Arms and Light Weapons in All its Aspects, UN document A/CONF.192/15, URL <http://www.http://disarmament.un.org/cab/poa.html>.

measures aimed at strengthening national, regional and international controls on SALW, many of which are applicable to shoulder-fired missiles. The UN Small Arms Process has also increased awareness of the threat posed by illicit arms trafficking and thrust the issue to the top of arms control, non-proliferation and counter-terrorism agendas worldwide.

Turning point: the Mombassa attack of November 2002

It was not until a pair of 24-year-old SA-7 missiles narrowly missed an Israeli airliner departing from Mombassa airport, Kenya, on 28 November 2002 that policymakers and the media became seriously concerned by the MANPADS threat. The attack marked a turning point in counter-MANPADS efforts.[26] In the USA there was a sea change in the emphasis and seriousness of existing inter-agency counter-MANPADS efforts. The attack prompted diplomatic efforts to expand the Elements and extend them to other international forums; the establishment of a multimillion-dollar programme for evaluating anti-missile systems for commercial airliners; and the expansion of foreign assistance programmes designed to secure foreign weapon stockpiles and destroy surplus weaponry. The attack had a similar (if more subdued) effect on the rest of the international community as well.

IV. Global counter-MANPADS efforts

Efforts to control the proliferation of MANPADS are truly global in scope. Over 100 countries are involved at some level, in ways that range from tacit support for one of the five multilateral agreements to the investment of significant diplomatic, budgetary and technical resources in a variety of initiatives. Israel, Russia, the USA and, more recently, Australia have been the most active states.[27] They have provided technical and financial assistance to other governments, spearheaded negotiations on regional and international agreements, and invested heavily in anti-missile systems for commercial aircraft. Together, these initiatives have significantly reduced the number of surplus and poorly secured MANPADS in national stockpiles and have taken hundreds of stray missiles out of circulation. The benefits from other initiatives are less certain, including the costly anti-missile programmes (see below). It appears that little progress has been made on other promising strategies, including the development and installation of launch control devices.

Below is a brief summary of each of these initiatives along with an assessment of their strengths and shortcomings. In isolation, none of these initiatives is sufficient to counter the MANPADS threat. However, if integrated into a coordinated multinational effort and supplemented with hitherto neglected tools such as launch control devices, these initiatives would provide a formidable layered defence against MANPADS attacks.

[26] Kuhn, D. A., 'Mombassa attack highlights increasing MANPADS threat', *Jane's Intelligence Review*, vol. 15, no. 2 (Feb. 2003), p. 29; UN Security Council (note 9); and Lacey, M., 'Investigation in Kenya: missiles fired at Israeli plane are recovered', *New York Times*, 7 Dec. 2002.

[27] In 2005 Australia launched an initiative to raise awareness of the threat, restrict MANPADS production capabilities, strengthen export controls, establish programmes to secure national arsenals and destroy surplus stocks, and improve airport perimeter security. See Downer, A., Australian Foreign Minister, 'Australia's International MANPADS Initiative', Speech at the Millennium Hotel, New York, 18 Jan. 2007, URL <http://www.foreignminister.gov.au/speeches/2007/070118_manpads.html>.

Export controls

Strong, harmonized, properly enforced national export controls are essential for preventing the diversion of weapons to irresponsible or unstable recipients. Unauthorized transfers arranged by globe-trotting arms brokers have resulted in the delivery of hundreds of weapons to rogue governments and rebel groups worldwide. In some cases, the complexity of the transaction and the extensive involvement of corrupt, high-ranking government officials make the diversion difficult to detect and foil.[28] In other cases, however, even minimal safeguards are enough to scuttle an attempted diversion. A good example is the shipment of 3000 Nicaraguan AK-47 assault rifles to Colombian paramilitaries in 2001. The broker who arranged the deal falsely claimed that his client was the Panamanian National Police—a claim that Nicaraguan officials failed to investigate. According to the Organization of American States (OAS) investigators, 'One telephone call [to Panama] could have prevented the entire arms diversion'.[29]

Since 2002 governments have taken several important steps towards strengthening national export controls on MANPADS, including regional and bilateral agreements aimed at promoting information exchanges on MANPADS transfers,[30] the expansion of the UN Register of Conventional Arms to include MANPADS, and, most significantly, the adoption of an expanded version of the Elements.[31] The expanded Elements, which have been adopted by members of the Asia–Pacific Economic Cooperation (APEC) forum, the OAS, the Organization for Security and Co-operation in Europe (OSCE) and the WA build on the original Elements by: (*a*) prohibiting the use of general supply agreements, thereby ensuring that each export request is properly vetted by trained government personnel; (*b*) banning the use of non-governmental brokers, who, as explained above, have diverted hundreds of weapons to embargoed states and non-state actors; (*c*) encouraging the development of technical performance or launch control features, which could limit the utility of lost, stolen or diverted missiles and reduce access to such missiles on the black market; (*d*) expanding the list of specific stockpile security procedures required of importers to include continuous (24-hour) surveillance and two-person entry requirements; (*e*) restricting access to hardware and related classified information to government personnel with proper security clearances and an established need to know; (*f*) sharing information on potential recipient governments that fail to satisfy these requirements and on non-state actors that are attempting to acquire MANPADS; and (*g*) imposing adequate (criminal) penalties for violations of national MANPADS export controls.

Particularly important is the provision calling for producer countries to 'implement technical performance and/or launch control features for newly designed MANPADS

[28] E.g. UN Security Council (note 9), pp. 46–9.

[29] Organization of American States, Report of the General Secretariat of the Organization of American States on the Diversion of Nicaraguan Arms to the United Defense Forces of Colombia, 29 Jan. 2003, URL <http://www.oas.org/OASpage/NI-COarmas/NI-COEnglish3687.htm>.

[30] E.g. the US–Russian arrangement on cooperation in enhancing control of MANPADS, which was signed at Bratislava on 24 Feb. 2005, URL <http://bratislava.usembassy.gov/pas/pr092en.html>; and the Commonwealth of Independent States resolution on measures to control the international transfer of Igla and Strela MANPADS, which was signed at Yalta on 19 Sep. 2003.

[31] The versions of the Elements adopted by the OAS, the OSCE and APEC differ slightly from the WA's version and from each other's. E.g. the OAS excluded the provision on launch control features but explicitly called for a ban on transfers to non-state entities. The Elements have also been endorsed by the UN General Assembly and the International Civil Aviation Organization.

as such technologies become available to them'. One such device touted for this role by Robert Sherman, the former director of the Advanced Projects Office at the US Arms Control and Disarmament Agency, is the controllable enabler—a device that requires the entry of a code to activate the missile. The missile could be enabled for any length of time, but after the code expires the missile will be useless until it is re-entered.[32] Installation of such devices would not only shorten the life of lost, stolen and diverted missiles but would also reduce black market trafficking. Terrorists are unlikely to plan attacks around weapons that may stop working before an attack, and arms traffickers are unlikely to invest tens of thousands of dollars in merchandise that may be useless a week later. Yet, despite their potential as tools for limiting proliferation, these features remain drawing-board concepts.

Several states have taken steps to implement the Elements. In 2004 South Korea 'put in place systematic control mechanisms for the international transactions of MANPADS prior to the adoption of the APEC guidelines', and New Zealand is 'looking to enhance existing end-user controls for MANPADS'.[33] Other governments have made changes to their export controls that go beyond what the Elements explicitly require. Russia recently started including provisions in its contracts for Igla missiles that give Russian inspectors the right to conduct physical inventories of exported missiles.[34] US end-use monitoring of Stingers is even more rigorous. While Russia simply reserves the right to inspect exported missiles, US regulations require annual inspections, and in 2003 the US Department of Defense (DOD) raised the percentage of exported Stinger missiles that its officials must annually inspect from 5 per cent to 100 per cent, meaning every exported missile must be inspected every year by a US team.[35]

In addition to their norm-building value, these agreements provide formal and informal opportunities for exchanging information, sharing best practices, and education and training. The OSCE has hosted a number of workshops, seminars and special meetings, during which the control of small arms—including MANPADS—was discussed.[36] The same goes for APEC, which has served as a venue for teaching members how to conduct MANPADS vulnerability assessments at airports and how to recognize MANPADS and their component parts.[37]

While these agreements are critically important, they also have significant limitations. APEC, the OAS, the OSCE and the WA lack the mandate, staffing and resources to systematically monitor and assess implementation, let alone to enforce compliance. However, there are informal mechanisms for self-policing among members of these organizations, such as information exchanges and opportunities to

[32] Sherman, R., 'The real terrorist missile threat, and what can be done about it', *FAS Public Interest Report*, vol. 56, no. 3 (autumn 2003), URL <http://www.fas.org/faspir/2003/v56n3/index.html>.

[33] See Asia–Pacific Economic Cooperation Counter-terrorism Task Force, 'Korea's response to leaders' and ministers' statements', Sep. 2005; and 'New Zealand efforts to respond to APEC leaders' and ministers' Statements', Sep. 2006—both available at URL <http://www.apec.org/apec/documents_reports/counter_terrorism_task_force.html>.

[34] Interview by the author with a Russian official, May 2005.

[35] US Defense Security Cooperation Agency, 'Revised guidance for stinger/man portable air defense systems (MANPADS)', 4 June 2003, URL <http://www.dsca.osd.mil/samm/policy_memo.htm>.

[36] E.g. Organization for Security and Co-operation in Europe, Technical Experts Workshop on Countering MANPADS Threat to Civil Aviation Security at Airports, 23 Jan. 2004, Vienna, URL <http://www.osce.org/item/3126.html>.

[37] Asia–Pacific Economic Cooperation Counter-terrorism Task Force, CTTF Chair's Summary Report, 14 Sep. 2005, URL <http:// www.apec.org/apec/documents_reports/senior_officials_meetings/2005.html>.

'name and shame' delinquent governments, but reports on implementation efforts are often vague or incomplete and the collegial nature of these institutions discourages direct confrontation.

Additionally, several key states—including producers such as Iran, North Korea and Pakistan—are not members of any of the multilateral institutions through which these agreements were negotiated and are therefore not obliged to follow them. At least one of these states (Iran) has allegedly acted against the most important provision of the Elements: the ban on transfers to non-state actors.[38]

Stockpile destruction

Since 2002, several countries and multilateral institutions have assisted with the process of destroying surplus, seized or obsolete MANPADS. The largest provider of such assistance is the USA, which has funded the destruction of approximately 29 000 missiles in 18 countries,[39] including 1300 as part of North Atlantic Treaty Organization (NATO) destruction programmes in Kazakhstan and Ukraine.[40]

The circumstances surrounding individual destruction projects vary significantly. In some cases, the missiles are part of massive, ageing, cold war-era government stockpiles intended for use against an enemy that no longer exists. Stockpiles in Nicaragua and Ukraine are good examples. Before the US-funded destruction programme began in 2003, Nicaragua had 2000 first- and second-generation Soviet missiles and no potential adversaries with more than a handful of functioning attack aircraft. Similarly, Ukraine, which served as the main Soviet military supply depot for the Western theatre, was saddled with over 2 million tonnes of surplus weapons—including thousands of MANPADS—after the cold war ended.[41] The Ukrainian missiles were destroyed as part of a 12-year, $27 million NATO programme to pare down the massive stockpiles, which have leaked into the black market and sparked accidental explosions that have killed several people and caused millions of dollars in damage to neighbouring towns.[42]

At the opposite end of the spectrum are the small caches of missiles in countries such as Bolivia and Liberia. Some of these missiles, like Bolivia's Chinese-made HN-5, are the remnants of legitimate but outdated and deteriorating national air defence systems. Others are the ill-gotten gains of rebel groups and embargoed governments, such as the regime of previous Liberian President Charles Taylor. In the case of Bolivia, US intelligence operatives worked closely with Bolivian officials to surreptitiously transport the 28 or so missiles to the USA,[43] where they were dis-

[38] On supplies of arms by states to rebel groups, see chapter 10 in this volume.

[39] This number includes 8000 missiles that, as of Mar. 2007, had not been destroyed but that the US State Department had received 'commitments' to destroy. Schroeder, M., 'Bush gets it right on small arms threat reduction', FAS Strategic Security Blog, 5 Feb. 2007, URL <http://www.fas.org/blog/ssp/2007/02/bush_gets_it_right_on_small_ar.php>.

[40] NATO Partnership for Peace Trust Fund, 'Status of trust fund projects', 9 Nov. 2006.

[41] Polyakov, L., *Aging Stocks of Ammunition and SALW in Ukraine: Risks and Challenges*, Paper 41 (Bonn International Center for Conversion: Bonn, 2005), URL <http://www.bicc.de/publications/papers/paper41/content.php>.

[42] US Department of State, 'Milestone reached in NATO Partnership for Peace arms destruction project in Ukraine', 21 Sep. 2006, URL <http://www.state.gov/r/pa/prs/ps/2006/72935.htm>; Polyakov (note 41).

[43] The number of missiles is a subject of debate. Estimates range from 19 to 38.

mantled and the pieces returned to Bolivia.[44] In Liberia, US officials sent to assist with the destruction of vast quantities of weapons left over from its civil war discovered 38 SA series missiles in Charles Taylor's presidential compound, which were described by one US official as 'the least secured MANPADS I had ever seen'.[45] The next day, they found four additional missiles in an unguarded shed on the private property of a high-ranking member of Taylor's government.

Destruction assistance programmes are straightforward, comparatively inexpensive and effective: a missile that is dismantled will never fall into terrorist hands. Particularly noteworthy is the US Department of State's SALW destruction programme. In just five years and with a total budget of less than $50 million, the programme has significantly reducing the pool of MANPADS and other small arms that are vulnerable to theft, loss and diversion by facilitating the destruction of nearly 1 million small arms, including 29 000 surplus and unsecured missiles.[46]

There are, however, inherent limitations to these programmes and it is not clear how many of the remaining stray and unsecured missiles are accessible to destruction teams. Many governments are hesitant to give up their MANPADS, which they view as a critical component of their air defence systems or (when sold) as a source of hard currency. Other governments are leery of the destruction process, which they fear will turn into a 'blatant intelligence-gathering exercise' by the donor state.[47] Poor relations between donor states and potential recipients also preclude the establishment (or completion) of destruction programmes. US law prohibits Iran, North Korea and Syria—all producers or importers of MANPADS—from receiving US foreign aid, including stockpile security and destruction assistance.[48] In other cases, unrelated political disputes delay or derail potential programmes. Decades-old hostility between the USA and the Sandinistas, for example, brought a promising US-funded programme to destroy Nicaragua's MANPADS to a grinding halt in late 2004 when the Sandinista-controlled National Assembly passed a law allowing it to block the destruction of the military's weapons.[49] The destruction programme has been frozen ever since.

Finally, destruction programmes are not mandated, and indeed are unable, to deal with the problem of missiles already in the hands of terrorists, insurgent groups or other non-state actors (except in the special case of disarmament, demobilization and reintegration, DDR, programmes after conflict). The threat from these missiles, which, according to some US intelligence analysts number around 6000, must be addressed in other ways.[50]

For these reasons, destruction programmes are a necessary but, in themselves, insufficient component of any successful counter-MANPADS strategy.

[44] The cooperation of the Bolivian officials was not sanctioned by the Bolivian Government, however. New Bolivian President Evo Morales pledged to evict US military advisers from Bolivia and punish the officials responsible.

[45] Schroeder, Stohl and Smith (note 15), p. 124.

[46] Schroeder (note 39).

[47] Interview by the author with US State Department official, Nov. 2006.

[48] Section 620A of the Foreign Assistance Act of 1961 prohibits the provision of foreign aid to countries that the Secretary of State has determined 'has repeatedly provided support for acts of international terrorism'. Cuba, Iran, North Korea, Sudan and Syria are on the State Department's list of 'state sponsors of terrorism'.

[49] Dellios, H., 'Sandinista election victories worry US', *Chicago Tribune*, 21 Nov. 2004.

[50] Jehl, D. and Sanger, D., 'The reach of war: weapons; US expands list of lost missiles', *New York Times*, 6 Nov. 2004.

Physical security and stockpile management practices

Effective stockpile security and management is the *sine qua non* of non-proliferation strategies and therefore a vital component of global counter-MANPADS efforts. Recently, the OSCE compiled the first multilateral best practice guide on stockpile management and security procedures for MANPADS.[51] This groundbreaking document provides, in great detail, best practice guidance on physical security, access control, handling and transport, and inventory management and accounting control prcedures for MANPADS. The document advises that MANPADS should be banded and sealed in their original containers and chained together in clusters weighing no less than 225 kilograms (so they cannot be easily carried away), and the containers kept in concrete ammunition storehouses equipped with intrusion detection devices, tamper-resistant locks and high-security doors. The storehouses should be surrounded by two sets—outer and inner—of fencing and be continuously monitored, ideally by armed guards via closed-circuit television. All vehicles entering and leaving the storage facility should be subject to inspection. Missiles and launchers should be stored separately and brought together only for training, lot testing or in the event of hostilities. Access to the missiles should be denied to everyone except authorized personnel operating in groups of two or more, and each entry to the storage area should be recorded. Physical inventories should be conducted at least once a month at the unit level and less frequently (but regularly) at the installation and depot levels.

Too often, however, procedures at the national level fall far short of these 'best practices'. In extreme cases, such as in Liberia under the Taylor regime, safeguards are non-existent. Other governments are more cognizant of the need to protect their MANPADS but also fail to establish adequate safeguards. In one such case the military stacked its MANPADS in the crawl space under a barracks, assuming that any attempt to steal the missiles would be heard by the soldiers in the rooms above.[52] Even militaries with comparatively rigorous physical security and accounting procedures occasionally fall foul of national and international standards. In 1987 the US General Accounting Office (GAO) documented such problems at ammunition storage sites in West Germany. At one site 'Stinger missiles were stored in lightweight corrugated metal sheds with the word "Stinger" stenciled on the side'.[53]

Since 2002 control advocates have pursued several complementary initiatives aimed at bolstering PSSM practices. At the international level, members of APEC, the OAS, the OSCE and the WA have agreed through the Elements to export eligibility criteria that establish minimum PSSM standards for MANPADS recipients. These standards require each individual exporter to 'take into account . . . the adequacy and effectiveness of the physical security arrangements of the recipient government for the protection of military property, facilities, holdings, and inventories' and to 'satisfy itself' that the recipient is willing and able to securely store, handle, transport, use and dispose of its MANPADS by, among other things: (*a*) conducting monthly physical inventories of all MANPADS; (*b*) accounting by

[51] OSCE Forum for Security Co-operation, 'Annex C: man-portable air defense systems', *Best Practice Guide on National Procedures for Stockpile Management and Security* (OSCE: Vienna, Mar. 2006), URL <http://www.osce.org/fsc/item_11_13550. html>.

[52] 'Interview with David Diaz, Deputy Chief for conventional arms threat reduction at the US Defense Threat Reduction Agency', *FAS Public Interest Report*, vol. 59, no. 4 (2007).

[53] US Government Accounting Office, *Army Inventory Management: Inventory and Physical Security Problems Continue* (US Government Printing Office: Washington, DC, Oct. 1987), p. 37.

serial number for expended or damaged components; (*c*) storing missiles and firing mechanisms in separate locations and transporting them in separate containers; (*d*) providing 24-hour surveillance of MANPADS storage facilities; (*e*) allowing only groups of two or more authorized persons to enter storage sites; (*f*) bringing together missiles and launchers only for testing, training or use in battle; (*g*) limiting access to hardware and classified information to government and military personnel with proper security clearances; and (*h*) securely disposing of surplus stocks.[54] Through their membership in the above-mentioned institutions, nearly 95 countries, including all of the major MANPADS exporters, have agreed to these standards.

Complementing these initiatives are national and multilateral PSSM orientation and assistance programmes. Several countries—including Germany, the Netherlands, Norway, the UK and the USA—provide such assistance, either through bilateral initiatives or under the auspices of multilateral organizations such as NATO and the OSCE. Anecdotal evidence suggests that these programmes have resulted in many improvements to national PSSM practices. According to one US official, the USA's PSSM orientation and assistance programmes have helped to secure 'literally thousands' of MANPADS in every region of the world by helping foreign governments to 'complete 100 per cent inventories, institute regular surveys strengthened with external or senior-level audits, improve external security like fencing and lighting, improve staff training and rehearse security response, and standardize oversight procedures'.[55]

Other countries have unilaterally improved (or have committed themselves to improving) their PSSM practices since 2002. At the May 2006 meeting of APEC's Counter-terrorism Task Force, Russia pledged to '[optimize its] MANPADS storage facilities' through the installation of 'perimeter and site protection devices' and the introduction of 'strict rules regulating access to MANPADS'.[56]

However, the secrecy surrounding national PSSM practices and the absence of monitoring and enforcement mechanisms in international agreements precludes definitive conclusions about the extent and impact of these agreements and the improvements they have prompted. As explained above, the multilateral organizations through which the various iterations of the Elements and the OSCE's PSSM best practice guide were negotiated lack the mandate and the resources necessary to compile data on or assess implementation of the PSSM requirements. Some states provide detailed, publicly accessible summaries of their PSSM policies and procedures but they are the exception, and even in these cases it is often difficult, if not impossible, for outsiders to determine how widely and consistently the procedures are followed.

Interviews with knowledgeable government officials suggest that the PSSM practices of many governments fall short of international standards, and that the barriers to universal implementation of them are significant. A lack of political will and a reluctance to expose dysfunctional systems to outsiders hinder efforts to improve PSSM practices in some countries, while other countries are plagued by inadequate physical infrastructures and a lack of resources. Examples of the latter problem

[54] Wassenaar Arrangement (note 23).

[55] 'Q & A on shoulder-fired missile stockpile security', FAS Strategic Security Blog, 15 Mar. 2007, URL <http://www.fas.org/blog/ssp/2007/03/q_a_on_shoulderfired_missile_s.php>.

[56] Asia–Pacific Economic Cooperation Counter-terrorism Task Force, 'Counter-terrorism Action Plans: Russia', 26–27 May 2006, URL <http://www.apec.org/apec/documents_reports/counter_ terrorism _task_force.html>.

include unreliable electrical grids, which preclude the establishment of automated export systems and reduce the utility of automatic lighting and alarm systems, and computer shortages, which complicate efforts by officials to monitor PSSM practices at depots in remote locations.[57] Foreign assistance programmes can address some of these shortcomings, but not all of them.

Furthermore, even the best systems are far from perfect, as evidenced by problems discovered by investigators at US shoulder-fired missile storage sites. In 1994 the US GAO found 'serious discrepancies in the quantities, locations, and serial numbers' of shoulder-fired missiles, including Stingers. They also found broken alarm systems, missing fencing, inadequate locks on magazines and lax inspections of vehicles leaving storage areas. Three years later the GAO reported that the DOD had made 'progress toward better oversight of handheld missiles', but also that 'weaknesses remained', including inventory discrepancies and violations of DOD physical security requirements.[58] For these reasons, strong physical security and stockpile management practices are a necessary but in themselves insufficient component of global counter-MANPADS efforts.

Buy-back programmes

Historically, MANPADS buy-back programmes have a mixed track record. They are least successful when the targeted missiles are numerous and widely dispersed, and when one or both sides in a regional conflict are threatened by enemy aircraft. The US-led buy-back programme in Afghanistan—Operation Missing in Action Stinger (MIAS)—is a good example. Operation MIAS was launched in 1990 to collect the hundreds of Stinger missiles left in circulation after the campaign to oust the Soviet forces from Afghanistan. Official accounts of the programme are still classified, but information gleaned from media accounts and interviews with former government officials suggests that, as of 1996, as many as 600 of the missiles distributed to the mujahedin had not been recovered.[59]

Many factors account for this failure, most of which had little to do with the programme itself. The decentralized nature of the Afghan resistance led to the widespread dispersal of missiles, and the need to maintain 'plausible deniability' limited direct US access to the battlefront and affected the ability of the CIA to track the missiles. Even when the CIA was able to locate stray missiles, the Afghan rebels' affinity for the Stinger—which became a status symbol in Afghanistan—and their ongoing struggle against the Afghan Air Force made it difficult to persuade the rebels to hand in the weapons.[60]

In contrast, the US operation to retrieve the missiles provided to Hussein Aideed, Somali National Alliance leader, by Eritrea in 1998 was very successful. In 2003 US operatives recovered 41 of the estimated 43 missiles given to the Somali warlord,[61]

[57] Interview by the author with US Government official, Nov. 2006.

[58] General Accounting Office (GAO), 'Vulnerability of sensitive defense material to theft', Sep. 1997, URL <http://www.gao.gov/docdblite/summary.php?rptno=NSIAD-97-175&accno=159446>.

[59] Coll, S., *Ghost Wars* (Penguin Books: New York, N.Y., 2005), p. 11.

[60] Schroeder, Stohl and Smith (note 15), pp. 91–96.

[61] The number of missiles originally provide to Aideed is a subject of debate. Aideed claims that he received only 41 missiles, but other sources claim that he received at least 43 and as many as 45. UN Security Council (note 9), pp. 29–30.

who reportedly decided to sell them for $500 000 in cash.[62] In this case, most of the missiles were still in the possession of the original recipient, who was willing to surrender them after signing a truce with the Ethiopian Government in 1999.

Examples of ongoing buy-back efforts include the US programme in Iraq and the Russian programme in Chechnya. Starting in 2003, US troops in Iraq set up collection points throughout Iraq at which they reportedly paid $250 for each launcher and $500 for each missile.[63] While the total number of MANPADS collected through this programme is classified, media accounts and DOD press releases document the collection of at least 300 missiles. Information on MANPADS collected through Russia's SALW buy-back programme in the Southern Federal District of Russia is also incomplete. According to a Russian government official, the authorities pay up to $1000 per MANPADS, depending on the condition of the weapon. He could not, however, reveal how many missiles had been collected through this programme.[64]

If history is any guide, many of the same problems that plagued Operation MIAS are hindering the ongoing buy-back programmes in Chechnya and Iraq. As in the Afghan example above, non-state groups in both countries face enemies with active air forces, providing a strong military incentive to hold on to their missiles. In Iraq the missiles are also plentiful and probably widely dispersed. Another potential problem is the low payouts offered in both countries. Insurgents who are aware of the price that similar missiles fetch on the international black market may be holding out (or may have already sold their missiles) for more money.

Yet even in cases where conditions are conducive to collecting MANPADS, buy-back programmes should not be the sole strategy for countering the threat from stray missiles. Even the highly successful operation to buy back Eritrea's missiles from Aideed may not have recovered all of them. According to UN investigators, the SA-7 missiles used in the Mombassa attack may have been missiles that Aideed sold on the black market in Mogadishu before receiving the USA's offer.[65]

Active defence measures: airports and airliners

Rigorous airport perimeter security can help deprive terrorists of access to the areas that are most conducive to MANPADS attacks. In 2005 each APEC member agreed to conduct one MANPADS vulnerability assessment of at least one of their own airports by the end of 2006.[66] To assist governments with their assessments, guidance material for conducting such assessments was drafted by the International Civil Aviation Organization and placed on a secure website. Several countries have already completed at least one assessment, and others, including Canada and the USA, have

[62] Carmony, P., 'Transforming globalization and security: Africa and America post-9/11', *Africa Today*, vol. 52, no. 1 (fall 2005), p. 100.

[63] US Army, 'Anti-aircraft weapons out of terrorists' hands', Press release, 24 Aug. 2003.

[64] Interview by the author with Russian official, May 2005.

[65] UN Security Council (note 9), p. 29–30.

[66] The purpose of the assessment is to 'identify the risk at each airport, and the recommended countermeasures that should be taken to deter a potential attack'. See Asia–Pacific Economic Cooperation (APEC), Joint Statement, 17th APEC Ministerial Meeting, Busan, South Korea (15–16 Nov. 2005), URL <http://www.apec.org/apec/ministerial_statements/annual_ministerial/2005_17th_apec_ministerial.htm>; and Asia–Pacific Economic Cooperation (APEC), APEC Initiative on Reducing the Threat of MANPADS to Aviation Security, URL <http://www.apec.org/content/apec/documents_reports/annual_ministerial_meetings/2005.html>.

assessed multiple airports. The USA has taken the additional step of assessing foreign airports.

Because many MANPADS have a range of 5 kilometres or more, even the best funded and most rigorous perimeter security cannot possibly detect and thwart every attempted MANPADS attack. A 2005 study of arrival and departure patterns at Los Angeles International Airport found that a terrorist armed with an SA-7 could engage aircraft anywhere within a 2250 km^2 area surrounding the airport. This area would expand to around 12 000 km^2 if the more advanced SA-18 missile were used.[67] Given the difficulty of patrolling so vast an area, airport perimeter security is not, in itself, a practical or cost-effective counter-MANPADS strategy.

The same is true for anti-missile systems, which, of the various counter-MANPADS strategies pursued since 2002, have attracted the most attention. There are several types of anti-missile system, of which the most widely deployed are plane-mounted infrared countermeasures that use lasers, lamps or flares to deflect heat-seeking missiles away from targeted aircraft. Other systems direct microwaves or high-energy lasers at the missile, shorting its circuitry or destroying it altogether.

Several countries are studying the possibility of deploying anti-missile systems at airports or on airliners. Israel's programme is probably the furthest along. In January 2006 the Israeli Civil Aviation Authority certified the Flight Guard system, which dispenses pyrophoric, or 'dark', flares designed to decoy infrared-seeking missiles, and El Al airlines has reportedly installed the system on several of its aircraft.[68] In 2003 the US Department of Homeland Security (DHS) established the largest such programme—a multi-year evaluation of aircraft-mounted, infrared countermeasure systems that is now in the operational testing phase. Three years later the DHS launched a parallel programme to assess emerging countermeasure technologies, including ground-based lasers and microwaves.[69]

Anti-missile systems are the last line of defence against a MANPADS attack and are therefore a potentially important part of the counter-MANPADS efforts at the global level. However, cost, logistical demands, export control issues and other challenges may prevent the widespread deployment of these systems, particularly in the developing world. In 2006 the DHS estimated that installation of aircraft-mounted laser systems would cost approximately $1 million by the thousandth installation, and $365 per flight to operate and maintain. The DHS also reported that, after two years of work on converting the systems from military to civilian use, 'The risk remains moderate to high that the commercial airline's economic business model, which emphasizes high reliability and low cost, would be adversely impacted by the current prototypes.'[70]

Even if the DHS programme yields anti-missile systems that are relatively affordable and reliable, other counter-MANPADS efforts would still be required. Aircraft-mounted systems are ineffective against laser-beam-riding and command-line-of-

[67] Chow, J. et al., *Protecting Commercial Aviation Against the Shoulder-fired Missile Threat* (RAND Corporation: Santa Monica, Calif., 2005), URL <http://www.rand.org/pubs/occasional_papers/OP106/>, p. 14.

[68] Ari, T., 'El Al flares alarm UK union', *Flight International*, 7 Mar. 2006.

[69] Other protection measures that have been proposed focus on safeguarding aircraft fuel tanks to minimize damage in the event of a missile strike. Such measures include: strengthening fuselages; 'honeycombing' fuel tanks; and replacing space in the fuel tank with an inert gas as fuel is used up. Altering aircraft take-off and landing paths can also limit the area around an airport from which a MANPADS attack can be launched.

[70] Kirby, M., 'DHS says more counter-MANPADS work needed', *Flight International*, 8 Aug. 2006.

sight missiles. Furthermore, such systems can be overcome by a large salvo of missiles, would take years to install on all commercial airliners and provide no protection to passengers flying on planes of countries that choose not to equip their airlines with the systems. Ground-based microwave and high-energy laser systems provide protection against all types of MANPADS, but they are not as technologically mature or time-tested, may not operate effectively in all weather conditions and only protect aircraft flying into or departing from airports equipped with the systems.[71]

V. Conclusions

Since 2002, the international community has made significant progress in the battle against the proliferation and misuse of MANPADS. More than 95 countries have adopted agreements that set minimum standards for controls on MANPADS exports and dozens more have endorsed them. At least 21 000 stray, surplus and poorly secured missiles have been destroyed, and programmes to improve stockpile security have reduced the threat that thousands more will be dispersed. Buy-back programmes and covert operations have captured hundreds of illicit missiles in Iraq, Afghanistan, Somalia, southern Russia, and probably other countries. Vulnerability assessments have been conducted at hundreds of airports worldwide, and military anti-missile systems are being converted for civilian use.

However, the MANPADS threat persists, as evidenced by recent attempted and successful attacks in El Salvador and Iraq, and the MANPADS scare at the 2003 APEC conference in Thailand. Furthermore, non-state actors are unlikely to stop trying to obtain MANPADS as long as they are a potent means of air defence and an effective tool of terror. Space constraints preclude a complete list of recommendations for countering this threat, but a few merit at least a brief mention.

First, producer states should heed the exhortation in the Elements for Export Controls of MANPADS to develop 'launch control features' for installation in MANPADS. As of January 2007, no producer had incorporated such features into its MANPADS, although Russia and the USA have reportedly done preliminary research on them. Feasibility studies should be undertaken immediately, and the most promising technologies should be fast-tracked for production and installation.

Second, the OSCE's best practice guidelines for MANPADS stockpile management and security should be universalized, through either a global agreement or the adoption of binding agreements by other regional organizations. Ideally, any such agreement would include monitoring and enforcement mechanisms. As a minimum, regular information exchanges should be required and periodic implementation surveys conducted, and aggregate summaries of both should be made public when possible.

Third, export control, stockpile security and destruction assistance programmes should be expanded. Even US programmes—the largest and best funded in the world—operate on shoestring budgets. Their funding, and the funding of similar efforts by other governments, should be increased until they are commensurate with the size and seriousness of the threat they address.

[71] See Chow et al. (note 67), pp. 19–22.