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NUCLEAR TERRORISM
The New Terror of the 21st Century

RESHMI KAZI

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THE NEW TERROR OF THE 21ST CENTURY

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INSTITUTE FOR DEFENCE
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Introduction

India fully shares global concerns on nuclear terrorism and clandestine proliferation, which continue to pose serious threats to international security. Nuclear terrorism will remain a potent threat as long as there are terrorists seeking to gain access to nuclear material and technologies for malicious purposes. India is acutely conscious of this threat.

- **Prime Minister Manmohan Singh's statement**
at the Plenary of the Nuclear Security Summit
(March 27, 2012), Seoul

Thomas C. Schelling way back in 1979 while presenting an essay 'War and Politics'[1] envisaged that either in the 1980s or in 1990s, 'an organisation that is not a national government may acquire a few nuclear weapons.' The likelihood will grow as more and more national governments acquire fissionable material from their own nuclear programmes, their research programmes, their research-fuel programmes, or from the waste products of their electric power reactors.[2]

Schelling opines that there may be several ways for an entity with the required motive, capability and the necessary opportunities to obtain weapons-grade fissile material for weapons use. One such way is theft of an intact weapon. Though, there have been no confirmed reports about the theft of an intact nuclear weapon, one cannot remain

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1 This essay was originally presented at the Conference 'War and Politics', held in November 1979 at the University of California, Los Angeles and sponsored by the Centre for International and Strategic Affairs.

2 Thomas C. Schelling, 'Thinking about Nuclear Terrorism', *International Security*, 6(4), 1982, p. 61.

complacent about such a possibility. Given the existence of thousands of operational nuclear weapons worldwide[3] and the large number of people entrusted with the 'custody, maintenance and transport of nuclear weapons'[4] there shall always remain a possibility for their diversion. Another way for a terrorist entity to procure a nuclear weapon would include the possibility of a 'gift'[5]. The 'gift' can be obtained either by force or by 'extortion' or a government possessing weapons grade fissile material or intact nuclear weapons can be subjected to 'blackmailing'. There also exists the possibility of 'purchase'. However, in matters of corruption, 'bribery and extortion' are so often together that gift, blackmail, and purchase can be thought of as unilateral intentional transfers motivated by various inducements.[6] Civilian and military officials operating responsible posts in nuclear weapons establishments of a country possessing nuclear weapons can also be a conduit for the passing of sensitive nuclear materials and information in wrong hands. The probability of these different routes by which nuclear weapons or materials might get diverted from official inventories into the hands of terrorists remain debatable. For now, this may be a speculation. However, in ten or fifteen years it may be a live performance.[7] All this will not be easy; it will take a long time. There will be the requirement of highly qualified nuclear scientists and engineers who share the vision of like-minded terrorists. All the individuals working towards the goal of unleashing catastrophic terrorism involving nuclear weapons will have to maintain extreme loyalty and discipline to work in secrecy and trust. Recruiting a group to carry out a whole act of nuclear terrorism will demand sophisticated planning, motivation and time to resort to the unique capability of weapons. However, the

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3 The global nuclear stockpile stands at roughly 19,000 nuclear weapons—the nuclear-armed states account for an estimated 420 of those weapons, while the nuclear weapon states have the rest. See Timothy McDonnell, 'Nuclear pursuits: Non-P-5 nuclear-armed states, 2013', *Bulletin of the Atomic Scientists*, January/February 2013, 69 (1).pp.62-70 and 'Status of world nuclear forces (2012)', *Federation of American Scientists*, at: *http://www.fas.org/programs/ssp/nukes/nuclearweapons/nukestatus.html* (accessed on January 27, 2013).

4 Thomas C. Schelling, 'Thinking about Nuclear Terrorism'op.cit., p. 62.

5 Ibid.

6 Ibid...

7 Ibid p.66.

terrorist groups resorting to the nuclear option may not be in any hurry. They will wait for the right opportunity to exercise the nuclear option so that finally if the terrorists do at all exercise the nuclear capability to unleash terror, they will be better prepared both intellectually and psychologically, than their adversaries.

The past decade has witnessed a significant rise in the profile of a security threat that has been a dominating issue in any discourse involving terrorism and nuclear weapons. Leading experts have been consistently warning about the danger of nuclear terrorism and the catastrophic risks that it holds for the security of the international community. The September 11, 2001 attacks on the Twin Towers of the World Trade Centre in New York City and the Pentagon in Arlington, Virginia wherein passenger air-liners were used as Weapons of Mass Destruction (WMD) to kill nearly 3000 people were a wake-up call to everyone. That the probability of terrorists conducting a nuclear explosion is remote, no longer remains an assuring argument. Terrorists have clearly indicated their intention to get nuclear weapons. Whether they build it, acquire it, steal it, or crash a plane into a nuclear power plant, the threat remains the same.[8] In fact, a unique characteristic of the use of nuclear capability by terrorists as a weapon of mass terror is that there is no innate limitation on the threat posed by it. One cannot specify how long a nuclear threat by terrorists can last. This is in sharp contrast to live hostages, hijacked ships or passenger airliners or occupied buildings that cannot be held indefinitely without risking the safety and security of the captors themselves. In fact, the sooner the captors are able to absolve themselves from the liability of their captives the better for the former. However, there is no such restriction on a nuclear threat posed by terrorists just as there is no guarantee that the nuclear weapons will be surrendered once the terrorists have successfully achieved their targets. In fact, the terrorists can employ the tactic of "compellent threat"[9] using nuclear weapons and may compel their adversaries to fulfill their demands. The problematic factor is submission "to a compellent threat

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8 Chris Bullock, 'Nuclear Terror: The Next Step?' *ABC News*, February 24, 2002 at http://www.abc.net.au/radionational/programs/backgroundbriefing/nuclear-terror-the-next-step/3499334 (Accessed April 2, 2012.

9 Thomas C. Schelling, 'Thinking about Nuclear Terrorism'op.cit., p. 72.

invites another demand"[10] and might only encourage more demands by terrorists. What is of concern is that there may not be any conclusive end to this.

The probability of non-state actors acquiring and using weapons of mass destruction against vulnerable non-combatants has remained a worrisome threat since the turn of the century. However, the watershed event of the bombing of the Twin Towers in New York on September 9, 2001 has significantly raised the concerns regarding Chemical, Biological, Radiological and Nuclear (CBRN) weapons and their probable usage. The reasons for increased concerns are varied. They include:

- widespread perceptions that the events of 9/11 marked the crossing of a threshold in terrorist constraint and lethality;[11]
- open source accounts of interest in WMD technology by non-state actors;[12]
- increased availability of WMD technology;[13]
- greater media attention; [14]

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[10] Ibid.

[11] Prior to 9/11, no terrorist attack had killed more than 500 people. In the 20th century, only 14 events have killed more than a 100 people. See Bruce Hoffman, 'CBRN Terrorism Post 9/11', Russell D Howard and James JF Forest (eds.), *Terrorism and Weapons of Mass Destruction,* McGraw-Hill, New York.

[12] On May 11, 2008, RIA Novosti reported that Russia's antiterrorism committee had said it had evidence that terrorists were trying to gain access to weapons of mass destruction and to technology needed to produce them as stated in Nancy K Hayden, 'Terrifying landscapes: Understanding motivations of non-state actors to acquire and/or use weapons of mass destruction', in Magnus Ranstorp and Magnus Normark (eds.), *Unconventional Weapons and International Terrorism: Challenges and new approaches* Routledge, New York, 2009, p. 188.

[13] See Matthew Bunn and Anthony Wier, 'Terrorist Nuclear Weapon Construction: How Difficult?' *Annals of the American Academy of Political and Social Science*, 607, pp.133-149.

[14] See Jonathan B Tucker, 'The proliferation of Chemical and Biological Weapons Materials and Technologies to State and Sub-State Actors', Testimony before the Sub-committee on International Security, Proliferation and federal Services of the US Senate Committee on Governmental Affairs, Washington, DC.

- persistent military presence of the West in global affairs and upsurge of anti-West sentiments;[15]
- vital role played by internet technology for Al Qaida in propagating its ideology and integrating its loose networks of affiliates and sympathisers.

Despite these important factors, one needs to ponder over the fact that it is just not enough to have heightened concerns about the threat of a probable CBRN attack by violent non-state actors. In qualitative terms, it is 'not the same thing as facing an actual increase in a threat'[16] and understanding the reasons for it. However, a comprehensive understanding of these factors is vital for developing an effective decision-making agenda in the interest of a successful national security and foreign policy strategy. According to John Parachini, 'Although, hedging against terrorists exploiting the catastrophic potential of CBRN weapons is an essential task of government resources…….attention cannot simply result in obsessing over CBRN effects but also must produce improved understanding of the motivations, vulnerabilities, capabilities and context for actual attacks, not just expressions of interest.'[17] Hence, in tackling the challenge of preventing politically violent terrorists groups and organisations resorting to the use of CBRN weapons, it is not enough to just secure all nuclear weapons and weapons usable nuclear materials. A sound policy would include concerted efforts to substantially dwell on an important question that is what factors drive violent terrorist groups like the Al Qaida to seek the most fearsome weapons. Unfortunately, research indicates that there is a paucity of statistical studies in analysing why terrorist groups particularly those grounded on religious ideology like the Al Qaida want to acquire and

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15 See Briggette Nacos, *Mass-Mediated Terrorism: The Central Role of the Media in Terrorism and Counterterrorism*, Littlefield Publishers , Lanham MD, 2007.

16 Nancy K Hayden, 'Terrifying landscapes: Understanding motivations of non-state actors to acquire and/or use weapons of mass destruction', in Magnus Ranstorp and Magnus Normark (eds.), *Unconventional Weapons and International Terrorism: Challenges and new approaches* (Routledge, New York: 2009, p. 164.

17 John Parachini, 'Putting WMD Terrorism into Perspective', *Washington Quarterly*, 26(4), pp.37-50.

use nuclear and other weapons of mass destruction. This difficulty is further cumulated by the existence of two factors:[18]

- the absence of any real nuclear attacks by terrorists that make any empirical analysis impossible
- the problems associated with the comprehension of the extent of attacks by terrorists using nuclear weapons.

Despite the above-mentioned problems, an attempt has been made in this study to analyse certain variables that provide a deeper understanding of the penchant of violent terrorist groups for weapons of mass destruction.

Concept of Nuclear Terrorism

The concept of nuclear terrorism is possibly the least understood of all dangers emanating from nuclear weapons. This is simply because no terrorist group is known to have developed, obtained, or deployed nuclear weapons. Hence, the severity of its threat remains debatable. Conventional notions indicate that nuclear terrorism is too difficult[19] to undertake since it would require substantial efforts, expertise, and competence on behalf of the perpetrators.[20] This conditional conclusion, coupled with the fact that no incidence of nuclear terrorism has been reported, reinforces the perceptions that while 'biological, chemical and radiological terrorism is likely, nuclear terrorism is improbable.'[21]

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18 See Magnus Ranstorp and Magnus Normark (eds.), *Unconventional Weapons and International Terrorism*, op. cit., p.15 – 21.

19 Gavin Cameron, 'Nuclear Terrorism Reconsidered', *Current History*, April 2000, p. 154.

20 Carson J. Mark, Theodore Taylor, Eugene Eyster, William Maraman, and Jacob Wechler, 'Can Terrorists Build Nuclear Weapons', in Paul Leventhal and Yonah Alexander (eds.), Preventing Nuclear Terrorism, The Report and Papers of the International Task Force on Prevention of Nuclear Terrorism, Lexington Books, Lexington, MA, 1987.

21 See Gavin Cameron, 'WMD Terrorism in the United States: The Threat and Possible Countermeasures', The Nonproliferation Review, 7 (1), Spring 2000, p. 172; Jerrold M. Post, 'Differentiating the Threat of Radiological/Nuclear Terrorism Motivations and Constraints', Paper presented at the International Atomic Energy Agency (IAEA), Symposium on International Safeguards: Verification and Nuclear Material Security, Vienna, Austria (2001, October 29–November 1) as stated in Morten Bremer Mærli, Annette Schaper and Frank Barnaby, 'The Characteristics of Nuclear Terrorist Weapons', American Behavioral Scientist, 46(6), February 2003, p. 743; DC Rapoport, 'Then and Now: What Have We Learned?', *Terrorism and Political Violence*, 13(3), Autumn 2001, pp. xi–xvi.

Some scholars have dismissed nuclear terrorism on the grounds of technical hurdles, internal factors such as geography and politics,[22] and have ridiculed it as 'an overrated nightmare'.[23]

For the purpose of this study, nuclear terrorism has been defined as:[24]

> Acts of violence and destruction performed by non-state actors where the means applied are nuclear explosive devices – or threats of such actions – with the purpose of inflicting destruction, creating a condition of fear, getting attention, blackmailing, installing instability, and to affect an audience beyond the victim(s) directly targeted.

The above definition indicates that the primary focus of this study would be on non-state actors intending to resort to the use or threat of use of nuclear explosives or devices with the purpose to instill fear and terror among the population in order to achieve certain objectives. Though, this is a narrow definition of nuclear terrorism, it has several implications. First, by referring to non-state actors, this study excludes the dynamics of nuclear politics and the appurtenant nuclear terror as an instrument of control and suppression in the inter-state domain. Non-state actors armed with nuclear explosives or devices will acquire powers that can supersede the power of the states and subject them to mass casualty threats. Terrorists can resort to the aforesaid tactics by keeping themselves outside the purview of the nuclear deterrence game and the method of mutually assured destruction whereby they can be confronted. However, as non state actors are primarily obscure, elusive and resort to asymmetric warfare, there is not much that the military can do to neutralise the terrorists. Hence, any act of nuclear terrorism will be unprecedented and forever change our perception of security.

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[22] Bernard Anet, Ernst Schmid, and Christoph Wirz, 'Nuclear Terrorism: A Threat to Switzerland?' Spiez Laboratory, Defence Procurement Agency at *http://www.vbs.admin.ch/acls/e/current/fact_sheet/nuklearterrorismus/pronto* (Accessed October 30, 2003).

[23] Karl-Heinz Kamp, 'An Overrated Nightmare', *Bulletin of the Atomic Scientists*, 52(4), July/August 1996, pp. 30–34.

[24] Morten Bremer Maerli, *Atomterrorisme* (*Atomic Terrorism*, in Norwegian), Norwegian Institute of International Affairs, Oslo, 1999, p.24.

Second, this definition recognises the severity of credible nuclear threats or nuclear hoaxes and its consequent devastation.

Problems Associated with Nuclear Terrorism Studies

Reaching a consensus on the probability of nuclear terrorism is difficult given its controversial and highly politicised nature. Coupled with this is the fact that there has been no established record of any act of nuclear terrorism. However, even though the concept of nuclear terrorism remains unprecedented, the risks associated with terrorists resorting to the unleashing of nuclear terror has not diminished.[25] This complex setting surrounding the issue of nuclear terrorism poses significant challenges to scholars and experts dealing with this low probability but high consequence threat. Any public discourse on nuclear, chemical and biological terrorism is thus fraught with several problems. While on the one hand, scholars like Richard Falkenrath[26] believe that given the catastrophic consequences, any risk concerning nuclear, biological or chemical terrorism must be given priority among all national security issues and dealt with proper precautionary measures. The academia will have a unique task of engaging in dialogue and will have to 'contribute to the development of knowledge and knowledge-based assets and should enthusiastically participate in the social, cultural, economical and technological developments of society.'[27] Experts will have to undertake special responsibility to mobilise public opinion for a common understanding on the significance of the nuclear threat and generate substantial political action for countering the risk.

On the other hand, any embellishment of the risk might over-state the threat, and could lead to alarmist reactions. Research findings and science may be misused, suppressed, or distorted to suit political and ideological

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[25] Falkenrath, Mathew Bunn, Graham Allison, Magnus Ranstorp and Magnus Normark (eds.), *Unconventional Weapons and International Terrorism: Threat Convergence in the Twenty-First Century* Routledge, New York, 2009.

[26] Richard A. Falkenrath, 'Confronting Nuclear, Biological and Chemical Terrorism', *Survival*, 40(3), 1998.

[27] See University of Oslo 'Langtidsplan 2000–2004 – Universitetet i Oslo', Long-Term Plan 2000–2004 University of Oslo, Norwegian, January 25, 2000 at *www.uio.no/ om_uio/ langtidsplan/ langtidsplan.html* (Accessed February 12, 2004).

goals.[28] Research findings by scientists may be selectively referred to and misappropriated and then sent for political decisions leading to uninformed, irrelevant and subjective analyses.

Again, restrained scholarly assessments could inspire and assist perpetrators.[29] Potential nuclear terrorists could start off significantly higher on the learning curve after studying some of the available papers and reports on nuclear explosive devices.[30] The present literature on nuclear terrorism lacks consensus on the issue whether terrorists might be at all able to devise and resort to the use of nuclear weapons. There is a significant difference among terrorism experts on the issue of nuclear terrorism as a plausible phenomenon. The lack of consensus is partly because of absence of utilisable information and partly because of lack of forceful efforts to pursue research on catastrophic terrorism involving weapons of mass destruction on the basis of data much of which is based on speculation. The lackadaisical attempts to use speculative data and then empirically assess them with social science tools and methods have left much of the available data as unusable to reach conclusions on the threat of nuclear terrorism. One school of thought presents the alarmist view, which considers that the likelihood of nuclear terrorism is high and increasing.[31] It is urgent that governments

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[28] See United States House of Representatives, Politics and Science in the Bush Administration Committee on Government Reform – Minority Staff Special Investigations Division, Washington, DC, August 2003 at www.house.gov/reform/min/politicsandscience/ (Accessed October 30, 2003) and Union of Concerned Scientists, Scientific Integrity in Policymaking. An Investigation into the Bush Administration's Misuse of Science, Washington, DC, February 2004, at *www2.ucsusa.org/global_environment/rsi/page.cfm?pageID=1322* (Accessed February 22, 2004).

[29] See, Francesco Calogero, 'Nuclear Terrorism: Likely Scenarios, Preventive Actions', Paper presented at the Annual Pugwash Conference, Halifax, Nova Scotia, July 2003 and Tonya L. Putnam, 'Communicating Nuclear Risk: Informing the Public about the Dangers of Nuclear terrorism', Workshop Report, Centre for International Security and Cooperation, May 20, 2002, at www.ciaonet.org/wps/put01/put01.html (Accessed March 2, 2007).

[30] David Albright, 'Secrets that Matter', *Bulletin of the Atomic Scientists*, 56 (6), November/December 2000, p.58.

[31] See Alvin Toffler, 'Third Wave of Terrorism Rides The Tokyo Subway', *New Perspectives Quarterly*, Vol.12 No 3, 1995, pp. 4-76; Joseph D Doughlass, Jr., and Neil C Livingstone, *America the Vulnerable: The Threat of Chemical and Biological Warfare* (Lexington, Mass.(DC Heath & Co., 1987): 'Coping with Biological Terrorism', in Brad Roberts, (ed.), *Biological Weapons: Weapons of the Future?* Centre for Strategic and International Studies, Washington, DC: 1993, pp.35-46.

take adequate measures since catastrophic acts of terror are inevitable. The other view is characterised by the more complacent school[32] that believes terrorist groups will remain dominated by low-level attacks resulting in only limited casualties. Hence, any elaborate measures to combat nuclear terrorism are not only futile but also a waste of government money and resources.[33] Another problem associated with any study on nuclear terrorism is that the scholarly and policy discussion seems to have reached something of an 'interpretive impasse'[34] with the literature increasingly beginning to recycle the same interpretations and staid shibboleths.[35] A better way to approach the difficulties surrounding research on nuclear terrorism would be to adopt a prescriptive approach, which would first establish the probability of a nuclear attack by terrorists and then determine measures to counter such possibility. The prescriptive approach will be fraught with risk of prediction and speculations that has its own obstacles. Speculations based on extrapolation from past events and probing into information whether recorded or unrecorded are essential while dealing with potential threats like the use of nuclear explosives by terrorists. However, terrorist behaviour and nuclear technology are both dynamic in nature. Hence, any analysis based on terrorist behaviour and nuclear technology of recent past or the present may not always be the perfect guide to study a dynamic and complex issue like nuclear terrorism. Brian Jenkins rightly emphasises that historical analysis provides no

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[32] Karl-Heinz Kamp, 'An Overrated Nightmare', *Bulletin of the Atomic Scientists*, 52(4) July/ August 1996, pp. 30–34; K Scott McMohan, 'Unconventional Nuclear, Biological and Chemical Weapons Delivery Methods: Whither the "Smuggled Bomb"', *Comparative Strategy*, 15(2)April-June 1996, pp. 123-134; Wayne Biddle, 'It Must be Simple and Reliable; Weapons and Bombs Used by terrorists', *Discover*, June 1986.

[33] The limited effects of the chemical attacks by the Aum Shinrikyo cult in 1995 and the US anthrax attacks of 2001 are often cited as examples by this school.

[34] The DECiDe Framework is being developed by the Centre for Terrorism and Intelligence Studies and is based upon earlier work on assessing terrorist target selection. The developers of the DECiDe Framework purposely do not refer to it as a model since they wish to avoid the implication of a deterministic system. DECiDe merely offers a rigorous set of guidelines and will leave the ultimate conclusions in any particular case to the analysts themselves.

[35] Magnus Ranstorp and Magnus Normark (eds.), *Unconventional Weapons and International Terrorism*, op. cit., p.14.

reliable basis for forecasting catastrophic terrorism involving CBRN terrorism.[36]

The problems underlying any discussion on nuclear terrorism are several. Yet, it is simply difficult to lay aside any study as merely irrelevant or alarmist. The head of the United Nation's Terrorism Prevention Branch (TPB) has rightly remarked that the greatest challenge in evaluating the WMD terrorist threat is 'walking the fine line between fear and paranoia on the one hand, and prudence and disbelief on the other.'[37] Thus, a more balanced perspective is found in a middle ground approach that incorporates elements from both the complacent and alarmist viewpoints. It acknowledges that while the threat of nuclear terrorism may be limited, the possible consequences of such attacks are so high and severe that it warrants serious consideration by states. Therefore, the threat of nuclear terrorism merits judicious risk assessments that allow for threat understanding and for proper countermeasures to be installed, without catering to hysterical doomsday fears or arguments that deny any validity to the prospects of CBRN terrorism.[38]

The attacks of September 11, 2001 have led to the belief that in the present-day terrorism, there are 'no limits, no constraints – nothing that is off the table'.[39] Today's terrorists operate with apocalyptic motivations to unleash cataclysmic disaster on their targeted enemies. In 1996, Osama bin Laden asked Khaled Sheikh Mohammed, the principal planner behind the 9/11 deadly attack, 'Why do you use an axe when you can use a bulldozer?'[40] Mohammed, during his

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36 Brian Jenkins, 'The WMD Terrorist Threat—Is There a Consensus View?', in Brad Roberts (ed.), *Hype or Reality? The "New Terrorism" and Mass Casualty Attacks* Chemical and Biological Arms Control Institute, Alexandria, VA 2000, pp. 242, 245.

37 A. Schmid, 'Terrorism and the Use of Weapons of Mass Destruction: From Where the Risk?', M. Taylor and J. Horgan (eds.), *The Future of Terrorism,* Frank Cass, London, 2000, pp. 106–32.

38 Centre for Counterproliferation Research, 'Chemical, Biological, Radiological and Nuclear Terrorism: The Threat According to the Open Literature', National Defence University, May 31, 2002 at www.ndu.edu/centercounter/CBRN_Annotated_ Bib.pdf October 28, 2002.

39 Paul J. Smith, *The Terrorism Ahead: Confronting Transnational Violence in the Twenty-first Century*, ME Sharpe, New York, 2008, p.104.

40 See Graham Allison, *Nuclear Terrorism: The Ultimate Preventable Catastrophe,* (Henry Holt, New York, 2004), p.19.

interrogation revealed that by 'axe' bin Laden referred to the proposal to charter a small plane filled with explosives and crash it into the Central Intelligence Agency (CIA) headquarters in Langley, Virginia. Bin Laden gave instructions to Mohammed to devise a more dramatic, devastating blow against the 'hated enemy'.[41]

The threat of nuclear terrorism is no longer a 'hypothetical worry; it is an ongoing reality.'[42] The prevailing factors within the international security calculus indicate that the danger of nuclear terrorism is likely to increase in the absence of substantial changes in the international policies and practices as part of the comprehensive non-proliferation efforts. At the same time, it can be assumed that small terrorist organisations that are relatively young, inexperienced and with no territory of their own will chose the least risky and most reliable tactical form of attack. Hence, it can be presumed with a fair degree of certainty, that only large well established and well networked organisations will seek to attempt CBRN terrorism. What are the drivers that propel terrorist organisations of the likes of Al Qaida to seek the most catastrophic weapons?

Drivers that propel terrorist organisations of the likes of Al Qaida*

State assistance

The idea of state support to terrorist organisations does not essentially entail that the state will assist in the direct provision of sensitive fissile material into wrong hands. Rather, it indicates that a terrorist group with WMD inclination and supported by the state will have better access to funding, sophisticated weaponry, and logistical and technical support. The organisation would possess a higher level of resources and technical expertise than it would otherwise be able to muster, while at the same time its strategic calculus would be less constrained by the

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41 See Georg Mascolo and Holgar Stark, 'Operation Holy Tuesday', *New York Times,* October 27, 2003.

42 Matthew Bunn, 'Securing the Bomb 2008', *Belfer Centre for Science and International Affairs*, Harvard University, November 2008, p. 8.

* For this part also see Reshmi Kazi "Non - State Actors and Weapons of Mass Destruction: A Study of Correlation", *IFPS Occasional Paper*, December 2011, Knowledge World.

need to maintain the support of a wider popular constituency.[43] It is arguable, for instance, whether Al Qaida would ever have been able to set up its chemical and biological weapons 'laboratories' in Afghanistan, or pursue its nuclear ambitions while in Sudan, were it not for the hospitable environment provided by the anti-Western governments of these states.[44]

Technological development:

It can be estimated that the advanced the level of technological development of the state in which violent terrorist groups with a proclivity for WMD exist, the more likely it is that the terrorist groups will be successful in acquiring the requisite knowledge, skills, materials and equipment to develop nuclear or other forms of CBRN weapons. In recent years, the United Nations Conference on Trade and Development (UNCTAD) has developed an index of technological development.[45] However, this index does not provide any data on countries like Afghanistan, Sudan and Iraq. Nonetheless, according to eminent analysts, Victor H. Asal and R. Karl Rethemeyer, the UNCTAD index is highly correlated (0.86) with energy consumption per capita.[46] Thus, they settled on this widely available measure as an appropriate proxy for the technological level of the terrorist organisation's home state.[47]

Rooted in global economy:

Building and manufacturing nuclear and other WMD weapons demands availability to sources of knowledge that exits mainly in the Western spheres of influence. Much of this science and research data is easily accessible in the public domain like the internet, Ph.D theses and

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43 Brian M Jenkins, 'Defence Against Terrorism', *Political Science Quarterly*, 101(5)1986, p.778.

44 Centre for Nonproliferation Studies, 'Chart: Al-Qaida's WMD Activities', *Monterey Institute of International Studies*, May 13, 2005 at http://cns.miis.edu/other/sjm_cht.htm (Accessed June 7, 2010).

45 United Nations Conference on Trade and Development, *Indicators of Technology Development* (Geneva: United Nations, 2002).

46 Ibid.

47 Victor H. Asal and R. Karl Rethemeyer, 'Islamist Use and Pursuit of CBRN Terrorism', in Gary Ackerman and Jeremy Tamsett (eds.), *Jihadists and Weapons of Mass Destruction* CRC Press,Boca Raton 2009, pp.337-338.

declassified documents accessible in public and academic libraries. However, non-stae actors would still need essential training and research institutions to be proficient and capable to carry out their mission. This can be possible only with contact to scientists and engineers who are based in the host countries. The likelihood of terrorists acquring contacts with competent supporters can be expected to increase the more the host state is globally amalgamated with academic and scientific institutions worldwide.

Terrorist outfits would also significantly gain from the amalgamation of the host state with the global economy. The terrorists will require availability to sophisticated devices and materials that are not obtainable in the open markets of less developed countries. However, integration of such countries with the global economy will facilitate increased commerce that itself will generate bigger opportunities for terrorists to surreptitiously transport and take delivery of materials, blue-prints, weapons and devices among legitimate cargoes.

Nature of the regime:

The kind of government existing in the host nation of the terrorists extensively adds to their capability and motivation to involve in WMD terrorism through the unstable existing security parameters. Terrorists might find it difficult generally to operate in an autocratic environment where the state can exert greater police powers than is possible in a democracy.[48] However, non-state actors would be relatively able to operate more liberally if the wide-ranging effect of autocracy is lessend in the host state.

Internal disturbances:

Internal conflicts like civil strife and insurgency create political insecurity that accelerates the terrorists' search for WMD weapons and materials. Domestic volatility generates zones where the central authority becomes ineffective, thereby providing shelter bases where power is centralized by non-state groups or their political faction. This assists the building, developing, assembling and transshipment of materials, knowledge

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[48] Paul Wilkinson, *Terrorism Vesus Democracy; The Liberal State Response, Cass Series on Political Violence* (London: Frank Cass, 2000).

and technology needed to acquire and utilise weapons of mass destruction. For example, the partial control of Hamas over the Gaza Strip has made it possible for it to illicitly acquire a variety of lethal weapons. Civil wars can also deflect the time and attention of the less developed host nations, providing the terrorist groups to carry out their unlawful actions surreptitiously.

Embedded in the network of terrorist alliances:

The more a terrorist organisation is rooted in the network of global terrorist alliances, the greater the probability it is likely to pursue CBRN terrorism. To carry out an act of nuclear or other forms of WMD terrorism would require gargantuan planning and networking. This can be doable if the non-state actors are well connected with the global network of compatible minded terrorists.

Revenge:

If Al Qaida had informed that it would exterminate four million Americans, unless they pulled out from Saudi Arabia, the threat might have caused some alarm but the effect would not have been equal as with the attacks that followed in September 2001. Terrorist violence is a "costly form of signalling."[49] For the terrorists, the options are limited. They have to employ their scarce resources to convince their targets that the terrorists are ready to go to any extent to obtain their desired goals. Hence the obvious choice of the terrorists would be the most lethal means of spreading violence.

Scenario 1

The weakening of the nonproliferation regime particularly the breakdown of the Non Proliferation Treaty will erode comprehensive nonproliferation efforts. This is likely to scuttle the possibility of ushering substantial changes in the international policies and practices on the NPT regime. This in turn will cause a setback to the intelligence and law enforcement agencies that have spearheaded many counterterrorism missions. Consequently, this will severely compromise the security measures of global stockpiles of nuclear weapons and materials. The

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[49] Andrew H. Kydd and Barbara F. Walter, 'The Strategies of Terrorism', *International Security*, 31 (1) Summer 2006, p.50.

terrorists will take advantage of the weak security system to gain access to dangerous fissile material or nuclear weapons.

Scenario 2

The present domestic uncertainty arising out of the newly acquired nuclear capability of North Korea presents another worrisome scenario. Hypothetically, should the present regime of Kim Jong II fall from power because of internal turmoil or military coup, there is a possibility that nuclear weapons may go missing in the ensuing disorder and eventually fall in the hands of terrorists. Cash strapped North Korea may trade its missiles and nuclear expertise with other states that in turn may provide these warheads to terrorists.

Scenario 3

The growing civil unrest within Pakistan can divert the attention of the military safeguarding the nuclear assets within the country. Consequently, terrorists with insider assistance may gain access to Pakistan's fissile materials.

However, the above probabilities can be prevented by recognition of the threat of nuclear terrorism as real, by keeping ready a clear agenda to combat the threat and by pursuing it with timely action to reduce the risk of nuclear terrorism. To that extent, another scenario that can be drawn is the following.

Scenario 4

Vigilance can be stepped up globally in order to upgrade the security systems of sites housing dangerous nuclear materials. National laboratories should develop a new technologies to detect and counter unconventional weapons of all types. These sentinels must to be positioned in the multilayered defence of the country.

The probability of use of nuclear explosives and devices by terrorists is increasingly becoming more salient in international affairs with the growing sophistication and lethality of conventional forms of terrorism, the expansion of nuclear power and research reactors and their vulnerability to terrorist attacks and the possibility of access to weapons-usable nuclear materials in pilferage activities. In present times indicators like the sarin attacks by the Aum Shinrikyo, the 9/11 attacks

by Al Qaida, the AQ Khan nuclear black-market and its proliferation activities, the anthrax attacks of 2001, the emerging technologies, political instability—all amalgamate to make the global security environment more complex. In this complex scenario, the question that the international community faces is no longer *if* but *when* a terrorist entity will unleash a major nuclear attack. Nuclear terrorism is no longer a dramatic thriller. As the former United Nations chief Kofi Annan exemplified in his address to the Madrid Summit in March 2005, 'Nuclear terrorism is still often treated as science fiction. I wish it were. But, unfortunately, we live in a world of excess hazardous materials and abundant technological know-how, in which some terrorists clearly state their intention to inflict catastrophic casualties.'[50] The former Foreign Minister of Germany Joschka Fischer stated, '…the use of nuclear weapons by terrorists would not only result in a major humanitarian tragedy, but also would most likely move the world beyond the threshold for actually waging a nuclear war.'[51] Keeping in line with these grim warnings, this monograph argues that nuclear terrorism is no longer a science fiction. It argues that nuclear terrorism is a plausible phenomenon that deserves adequate consideration, substantial efforts, expertise and competence to combat it. Though there are good reasons for concern about the state of nuclear security worldwide, this work does not suggest an alarmist and overstated view. While referring to some distinct features of non-conventional terrorism, this paper focuses on how it is feasible for terrorists to obtain or develop nuclear weapons. What do the apocalyptic warnings from responsible officials intend to communicate? It further analyses whether terrorists will resort to the use or threat of use of nuclear devices if it successfully obtains them. The monograph seeks to explore the possibility of a methodological approach to analyse and discuss the multidimensional and complex nature of nuclear terrorism in the South Asian context since in the present times, the epicenter of nuclear terrorism is believed to be strongly embedded in this region. It concludes by exploring how seriously the threat of nuclear terrorism is taken in India and what further measures can be taken to combat this global threat.

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50 'Secretary-General Offers Global Strategy for Fighting Terrorism', in Address to Madrid Summit, *Press Release SG/SM/9757* at *http://www.un.org/News/Press/docs/2005/sgsm9757.doc.htm* (Accessed on April 4, 2012).

51 Joschka Fischer, 'The New Nuclear Risk', *Guardian*, March 31, 2008.

I The Danger of Nuclear Terrorism: An Indian Perspective*

Even more disturbing, however is the emergence of new threats and challenges to global security. I refer to the growing risk that nuclear weapons may be acquired by terrorists or those driven by extreme ideologies; the increasing danger of non-state actors, accessing nuclear materials and devices…Nuclear weapons know no boundaries.

Prime Minister Manmohan Singh
(Towards a World Free of Nuclear Weapons)
June 9, 2008, New Delhi.

The opinion that terrorists may be on the nuclear course has been reinforced particularly after the Aum Shinrikyo conducted sarin attacks in Tokyo in 1995 followed by the Oklahoma City bombing, which claimed 168 lives and injured more than 680 people. The anthrax attacks of 2001 were a further conviction of the terrorists' resolves to follow the path of WMD. In the last decade, the September 2001 attacks that killed nearly 3000 people, followed by the Car Bomb attacks in Bali, killing 202 people in October 2002, the Madrid Explosions of March 2004 killing 191 people, the attacks in Beslan in September 2004 killing over 330, several of whom were children; incidents like these have demonstrated the lethality of terrorist attacks.

Terrorist incidents in India have also strengthened the view of their increasing predilection for gruesome violence. Each incident raises the bar of lethality in terms of casualties and spread of terror amongst the survivors. Some major militant attacks on India in recent years include the March 2006 blasts in Varanasi attacks killing at least 15 people; and seven bomb explosions at railway stations and on trains in

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* Parts of this paper are already published by the author in 'The Danger of Nuclear Terrorism: The Indian Case', *Strategic Analyses*, Volume 33, Issue 4, July 2009, pages 498 – 515.

Mumbai by militants in July 2006 killing more than 180 people. In February 2007, two bombs exploded aboard a train heading from India to Pakistan. At least 66 passengers, most of them Pakistanis, were burnt to death giving India-Pakistan diplomatic relations a backseat. In May 2008, seven bombs ripped through the crowded streets of Jaipur, killing approximately 63 people; in July 2008, 16 small bombs exploded in Ahmedabad, killing 45 people and wounding 161. Later, the 'Indian Mujahideen' claimed responsibility for the attack July 2008 and the May attack in Jaipur; 11 bomb blasts that detonated in quick succession killed at least 68 people and injured 335 in Guwahati in October 2008; between November 26-29, 2008 coordinated bombing and shooting attacks by ten Pakistani gunmen from the Lashkar-e-Taiba (LeT) group killed 166 people in Mumbai. India blames the attacks on Pakistan-based militants, and the only surviving gunman[1] confessed they were members of the LeT. In July 2011, three explosions ripped through Mumbai during the rush hour, in a series of coordinated terrorist attacks killing at least ten people and injuring nearly 60 others. Although, these incidents have no direct correlation with terrorists and their penchant for nuclear weapons, yet they emphasise the growing level of fatality among the perpetrators of violence. These lethal incidents indicate the changes in the nature of the terror activities perpetrated by the non-state actors. They reinforce the belief that the world has entered into a new era in terms of violence and terror. These pointers indicate that now terrorists could seek to demonstrate higher levels of violence with the 'appropriate means'.

Nuclear Terrorism and the Indian Case

In recent years, the issue of nuclear security appears to have overshadowed the political agenda in several parts of the world including India. The threat of a probable nuclear attack by terrorists is gradually seeking attention and permeating concerns within the political leadership as well as the scientific establishment. Indian Foreign Secretary Ranjan Mathai speaking in New Delhi, where delegates from 49 nations convened to work on the agenda for the Nuclear Security Summit

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[1] The sole surviving gunman from the 2008 Mumbai attacks, Mohammad Ajmal Amir Kasab, was executed in November 2012 at Yerwada jail in Pune.

(NSS) held in March 2012 stated, 'The main objective of the nuclear summit process has been to focus high-level global attention on the threat posed by nuclear terrorism.'[2] The Indian official emphasised that the NSS is expected to spotlight the danger of terrorists acquiring and using nuclear weapons. There are several reasons for this emerging concern. First, the global debate on nuclear terrorism in the aftermath of the September 9/11 attacks has significantly influenced India's nuclear security discourse. Second, the evolving strategic ties between the United States and India has lead to emerging concerns of New Delhi being the target of Al Qaida, which considers the US and its allies as primary foes. While inaugurating a three-day conference of state police chiefs in New Delhi on November 22, 2006, India's former Home Minister Shivraj Patil said that the proposed civil nuclear deal with the US has made the country's atomic power plants and other critical infrastructure 'highly vulnerable' to terrorist attacks.[3] Third, India's rising apprehensions about nuclear terrorism also stems from the political instability prevailing in the nuclear capable country of Pakistan. The prevailing domestic turmoil coupled with terrorist-infested safe havens in several parts of Pakistan portrays it as a dangerous neighbour to India. Last, increasing reported incidents of loss of fissile material poses serious concern about a potential atomic attack by terrorists. Since 1993, nine trafficking cases involving uranium ore and low enriched uranium (LEU) have been recorded in India, one in Bangladesh and another in Pakistan.[4] In August 2001, the police in West Bengal revealed that they had arrested two men with more than 200 grams of semi-processed uranium.[5] The Indian intelligence officials stated that there is a uranium smuggling gang operating in the region. On May 1, 2000, Mumbai

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2 'Sherpas consider draft communique for Seoul Nuclear Security Summit', *2012 Seoul Nuclear Security Summit*, January 18, 2012 at http://www.thenuclearsecuritysummit.org/eng_media/news/news_view.jsp?oCmd=6&b_code=3&idx=161&rnum=83&f_gubun=0 (Accessed February 5, 2012).

3 'India-US nuclear deal makes Indian Nuclear Plants really vulnerable to Islamic Terror Targets: Indian Home Minister ShivrajPatil', *India Daily*, November 22, 2006 athttp://www.indiadaily.com/editorial/14359.asp (Accessed September 22, 2007).

4 See *Nuclear Black Markets: Pakistan, Khan and the rise of proliferation networks,* International Institute for Strategic Studies, 2007, p.130.

5 'Uranium smugglers caught in India', *BBC News*, August 27, 2001, at *http://news.bbc.co.uk/2/hi/south_asia/1512077.stm* (Accessed April 6, 2012).

police seized 8.3 kg of uranium[6], which was termed as depleted but radioactive uranium by the Bhabha Atomic Research Centre (BARC). In April 2005, uranium was seized from Assam, stolen by two men from a government facility from Shillong.[7] In addition, several intelligence reports have also exposed that India's nuclear infrastructure could be the target of terrorist attacks. On the eve of the Independence Day in 2006, security was stepped at the BARC with deployment of the elite National Security Guards (NSG) for the first time following inputs of a possible terrorist attack.[8] Fears were heightened over the possibility of the LeT infiltrating a nuclear power plant when reportedly three men were arrested for entering the Narora nuclear power plant with fake IDs in August 2006.[9] Intelligence agencies had information that LeT modules were planning to attack critical installations, possibly nuclear ones, and military targets.

The above reports are not meant to generate any alarmist propaganda. However, terrorist activities in recent times are only indicative that they intend to bring about cataclysmic disaster and will operate in a manner that will leave an apocalyptic impact on their desired targets.

Any discussion on nuclear terrorism must include an assessment of the motivation and capability of the terrorists to carry out an act of nuclear terrorism. It must also focus on certain technical questions. How feasible is it for terrorist groups to develop and deploy nuclear weapons? Can the terrorist groups successfully acquire the fissile materials? Have they mastered the relevant technical and scientific competence to develop a nuclear device? Do they possess the necessary delivery vehicles to launch them? The example of unsuccessful states with nuclear weapon programmes like Iran are often cited as evidence of the difficulties involved in developing nuclear weapon capabilities. 'Significant technical hurdles stand in the way of practicing nuclear terrorism in any form.'[10]

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6 *The Times of India*, May 6, 2000.

7 'Uranium Sting Nets 2 in India', *UPI*,April 11, 2005.

8 'Security Beefed up at BARC', *The Times of India,* New Delhi, August 13, 2006.

9 'Lashkar targeting N-sites: Special measures to check attacks: Pranab', *Tribune News Service* (Chandigarh), August 1, 2006.

10 Gavin Cameron, 'Nuclear Terrorism Reconsidered', *Current History*, April 2000, p. 154.

For purposes of this study, Al Qaida has been selected as the terrorist organisation seeking nuclear weapons since the existing literature on nuclear terrorism indicates that it is the only terrorist organisation that has the determination and will to explode a nuclear explosive.

Al Qaida and Nuclear Weapons

The goal of many terrorists particularly those with apocalyptic perspective is to acquire nuclear material or explosives to unleash catastrophic terror. Many of the 33 US State Department–designated Foreign Terrorist Organisations[11] (FTO) worldwide have expressed interest in chemical, biological, radiological, or nuclear (CBRN) capabilities. A September 2006 statement by Al Qaida in Iraq called on scientists to join the struggle in Iraq and produce unconventional weapons against American forces in that country.[12]Amongst terrorist groups, Al Qaida leadership in particular has shown a consistent interest in the development of a nuclear capability and other WMD potential. Former senior Al Qaida operations planner Khalid Shaykh Muhammad (KSM) confirmed in March 2003 that senior Al Qaida leadership—including bin Laden, Ayman al-Zawahiri, and Muhammad 'Atif' (a.k.a. Abu Hamza al-Masri)—all believed that obtaining a CBRN capability was necessary and that they were intent on developing weapons that could cause large numbers of casualties.[13] In May 2003, a Saudi cleric, Nasir Bin Hamad Al Fahd issued a *fatwa* justifying the use of nuclear weapons on infidels. In 'A Treatise on the Legal Status of Using WMD against Infidels', a 25 page fatwa, Fahd argues that the Western ban on use of WMD 'was not to protect humanity but to protect themselves

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[11] 'Unclassified Report to Congress on the Acquisition of Technology Relating to Weapons of Mass Destruction and Advanced Conventional Munitions, Covering 1 January to 31 December 2007', at http://www.fas.org/irp/threat/wmd-acq2007.pdf , p.6, (Accessed February 10, 2013).

[12] 'New Leader of Al-Qaeda in Iraq Calls for Use of Unconventional Weapons Against U.S. Forces; Possible Poisoning of Iraqi Security Forces at Central Iraq Base', *WMD Insights*, Issue 10, November 2006 at http://cns.miis.edu/wmd_insights/WMDInsights_2006_11.pdf, p.2. (Accessed February 10, 2013).

[13] James R. Van de Velde and Booz Allen Hamilton, 'The Impossible Challenge of Deterring "Nuclear Terrorism" by Al Qaeda', *Studies in Conflict & Terrorism*, 33(8) 2010, p.684.

and monopolize such weapons.'[14] In his *fatwa*, Fahd asserts that Americans and the West have killed 10 million Muslims and, therefore, 'If a bomb that killed ten million of them and burned as much of their land as they have burned Muslims land were dropped on them it would be permissible, with no need to mention any other argument.'[15] It is widely believed that the present Al Qaida leadership (in the aftermath of the demise of Al Qaida chief, Osama bin Laden) most likely adheres to this understanding.

Why the Nuclear Option?

A significant question that plagues the author is why should terrorist outfits like Al Qaida resort to the nuclear option? Unlike conventional weapons, a nuclear explosive will be an untested option and could bear operational difficulties for the terrorists. Despite the obstacles, the nuclear option could be an attractive one for the Al Qaida for several reasons. Nuclear weapons are characterised by their enormous lethality. A nuclear attack by means of a crude nuclear device can cause thousands of casualties. A bomb with the explosive power of 10,000 tons of trinitrotoluene (TNT) set off in Manhattan could kill half a million people, and cause $1 trillion in direct economic damage.[16] Nuclear materials like HEU have easy portability. It can be easily transported from one place to another. This increases the vulnerability of the fissile material being accessible to terrorists. Terrorists might take advantage of transportation risks and seize the fissile material. Once the necessary nuclear materials are within the reach of terrorists, they can easily smuggle it to their chosen destination. The necessary ingredients for a nuclear bomb can easily it into a suitcase, and can be hard to detect.[17]

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[14] Nasir Bin Hamad, 'A Treatise on the Legal Status of Using Weapons of Mass Destruction against Inûdels', *Rabi I 1424,* May 2003 *at* http://www.carnegieendowment.org/static/npp/fatwa.pdf(Accessed April 15, 2012).

[15] Ibid., p.8.

[16] Matthew Bunn and Anthony Wier, 'Controlling Nuclear Warheads and Materials: The Global Threat and Urgent Steps to Address It', Centre for Nonproliferation Studies, December 16, 2002 at http://www.nti.org/e_research/cnwm/overview/issue.*asp*l (Accessed November 23, 2003), p.4.

[17] Ibid., p.3.

Will Al Qaida adopt a nuclear strategy?

Is there a correlation between the Al Qaida and a nuclear option? Nuclear weapons are unlike any other conventional weapon. The traditional view of terrorism implies that by and large the terrorists do not want to go too far. Their goal is primarily fulfilled by being able to have in the words of Brian Jenkins, '…a lot of people watching, not a lot of people dead.'[18] Real terrorists, that is to say, those pursuing political aims are more interested in publicity than in a great number of victims.[19] Perhaps, this is one reason why John Parachini argues that so far only '…three completed or attempted terrorist mass casualty attacks involving unconventional weapons material' have taken place.[20]

However, the conventional view suggesting a minimal likelihood of terrorists using WMD has significantly evolved, particularly with the attacks on the WTC in September 2001. These attacks revised the conventional form of thinking and authorities began to seriously contemplate the possibility of WMD being used outside the context of general inter-state warfare by terrorist groups.. Richard Betts has argued that CBRN weapons, which were considered the 'technological frontier of warfare', and principal weapons of powerful states, have now increasingly evolved to be 'weapons of the weak –states or groups that militarily are at best second class.'[21] These WMD, which were symbolic of strength, are now believed to be the instruments of vulnerability and weakness making them, 'the only hope for so-called rogue states or terrorists who want to contest American

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18 www.terrorismanswers.org/terrorism/media.html.

19 Walter Luer, 'Weapons of Mass Destruction', in Pamela L. Griset and Sue Mahan (eds.), *Terrorism in Perspective,* Sage, London, 2003, pp. 239-240.

20 John V. Parachini, 'Comparing Motives and Outcomes of Mass Casualty Terrorism Involving Conventional and Unconventional Weapons', *Studies in Conflict and Terrorism*, 24 (5), September- October 2001, pp.390-391. The three cases are: (1) theRajneesh religious cult that attempted to influence a local election by poisoning the local people with *Salmonella typhymurium*; (2) the usage of chlorine gas by the Liberation of Tamil Eelam against the Sri Lankan military, which led to the injury of approximately sixty armed personnel; (3) the use of sarin gas by the Aum Shinrikyo cult against commuters in a Tokyo subway in 1995.

21 Richard K. Betts, 'The New Threat of Mass Destruction', *Foreign Affairs*, 77 (1) January-February, 1998, p.27.

power.'[22] Terrorist violence is a costly form of signalling. It is difficult for them to impose their will by the direct use of force. However, sometimes the terrorists are successful in persuading their targets to do as they wish by convincing the latter about their ability to impose high consequences and their determination to do so. Given the conflict of interest between terrorists and their targets, ordinary communication or 'cheap talk' is insufficient to change minds or influence behaviour.[23] If Al Qaida had informed that it would kill four million Americans unless they withdrew from Saudi Arabia, the threat might have caused some concern but the impact would not have been the same as with the attacks that followed in September 2001. Since it is hard for weak actors to make credible threats, terrorists are forced to display publicly just how far they would go to obtain desired results.[24]

Apart from using the method of terrorism as a form of signalling, it is also meant to be a means of 'diplomacy of violence'[25] whereby terror is induced in order 'to influence the political behavior of a given target group.'[26] NO Berry opines that terrorism is most effective 'when the target of terrorism acts in such a manner that it either loses public support for its political position or it lessens its own political capabilities.'[27] Neumann and Smith argues that terrorism is basically a psychological warfare where the 'aim of the strategy of terrorism is not to kill or destroy but to break the spirit and create a sensation of fear within a target group, which will initiate political change.'[28] Hence, terrorism has three distinct modus operandi:[29]

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22 Ibid., p.28.

23 Andrew H. Kydd and Barbara F. Walter, 'The Strategies of Terrorism', *International Security*, 31 (1) Summer 2006, p.50.

24 Ibid, p.51.

25 See Thomas Schelling, *The Strategy of Conflict,* Weidenfeld and Nicholson, Harvard, MA 1987, p.145.

26 Peter R. Neumann and MLR Smith, 'Strategic Terrorism: The Framework and its Fallacies', *The Journal of Strategic Studies*, 28(4)2005, p.577.

27 NO Berry, "Theories on the Efficacy of Terrorism," in Paul Wilkinson and AM Stewart (eds.), *Contemporary Research on Terrorism* Aberdeen University Press, Aberdeen 1987, p.293.

28 Neumann and Smith, 'Strategic Terrorism', *op. cit.,* p.577.

29 Ibid..p.13.

- Disorientation: to alienate the authorities from their citizens.
- Target response: to induce a target to respond in a manner that is favourable to the insurgent cause.
- Gain legitimacy: to exploit the emotional impact of the violence to insert an alternative political message.[30]

The strategy of inducing disorientation is 'to alienate the authorities from their citizens, reducing the government to impotence in the eyes of the population, which will be perceived as unable to cope with a situation of evolving chaos.'[31] The aim is to 'disorient the population by showing that the government is unable to fulfill primary security functions for its subjects: that is the provision of safety and order.'[32] This will certainly 'raise the level of fear in the community as the impression of being under siege would inevitably be intensified.'[33] Al Qaida adheres to this perspective. They do want to instill fear among the population and alienate them from the government. Any imposition of counter terror measures against the terrorists or disoriented population will further alienate the people and make them sympathise more and join the terrorists' cause. This strategy serves the dual purpose of the Al Qaida organisation, to reduce the credibility of the government and to expand its recruits from amongst the sympathisers. An example of such a scenario can be depicted from the prevailing situation in Pakistan.

However, going by Brian Jenkins' argument that terrorists want 'a lot of people watching, not a lot of people dead', it appears that terrorists have an aversion for mass killing. In that sense, a nuclear attack would unleash the most catastrophic form of horror and hence Al Qaida will refrain from it. But by logic, a threat assessment based solely on extrapolation from the past would be deceptive. Changes in the nature of non-state violence, in the ease in acquiring NBC weapons and in the role of the US suggest that the probability of significant non-state

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30 Ibid., p.572.

31 Ibid., p.95.

32 Grant Wardlaw, *Political Terrorism: Theory, Tactics and Countermeasures* (Cambridge University Press, Cambridge, 1982), p.34.

33 Ibid., p.182.

NBC attacks is greater now, and is growing.[34] The general aversion for mass killings among non-state actors is gradually diminishing due to large scale societal changes. The following table indicates the trends in terrorism:[35]

Period	Terrorist incidents	Deaths	Injuries
1970s	8,114	44,798	6, 902
1980s	31,426	70,859	47,849
1990 to 1996	27,087	51,797	58,814

The number of casualties in acts of terrorism varies from year to year but the trend is clearly increasing.[36] Between 1970 and 1995, on an average, each year brought 206 more incidents and 441 more fatalities.[37] The death toll from acts of international terrorism rose from 163 in 1995 to 311 in 1996 as the trend continued towards more ruthless attacks on mass civilian targets and the use of more powerful weapons.[38] In 1996, the number of international incidents declined but 'while terrorists were becoming less active, they were also becoming more lethal.'[39] The new statistics show that terrorist strikes against non-military targets worldwide remained virtually unchanged in 2007 from 2006, at roughly 14,500 attacks, but the number of deaths from those attacks increased to 22,685 from 20,872, according to statistics compiled by the National Counterterrorism Centre (NCTC).[40] In more recent

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34 Richard A. Falkenrath, Robert D. Newman and Bradley A. Tayer, *America's Achilles' Heel: Nuclear, Biological and Chemical Terrorism and Covert Attack,* MIT Press, Massachusetts, 1998, p.167.

35 Jessica Stern, *The Ultimate Terrorists,* Harvard University Press, Massachusetts, 2000, p.6.

36 Ibid.

37 Ibid.

38 US Department of State, *Patterns of Global Terrorism 1996,* (US Department of State, Washington DC., April 1997, p.1 at www.state.gov/global/terrorism (Accessed May 27, 2007).

39 Bruce Hoffman, 'Terrorism and WMD: Some Preliminary Hypotheses', *Nonproliferation Review*, 4 (3), (Spring-Summer 1997), p.47.

40 Eric Schmitt, 'Attacks in Pakistan Rising, State Department Reports', at http://www.nytimes.com/2008/05/01/washington/01terror.html?_r=1&scp=5&sq=nuclear&st=nyt&oref=slogin (Accessed May 2, 2008).

times, there has been a change in the statistics. In 2011, over 10,000 terrorist attacks occurred resulting in over 12,533 deaths indicating a decline in the total number of worldwide attacks in 2011 by almost 12 percent from 2010 and nearly 29 percent from 2007.[41] Although the 2011 numbers represent five-year lows, they also underscore the human toll and the geographic reach of terrorism.[42] The Near East and South Asia continued to experience the most attacks, incurring just over 75 per cent of the 2011 total.[43]

Al Qaida holds the dubious distinction of being the most destructive terrorist organisation of the world. The US State Department's annual *2007 Country Reports on Terrorism* states, 'Al Qaeda and associated networks remained the greatest terrorist threat to the US and its partners in 2007.'[44] Al Qaida's psychological capacity for mass killing has been repeatedly demonstrated.[45] According to the International Center for Terrorism Studies what remains of significant concern is the disturbing and evolving reality that Al-Qaeda in the Islamic Maghreb (AQIM) and its affiliates have already carved out in the failed and fragile states bordering the Sahara(northern Mali) a safe-haven and a breeding ground for jihadists in Africa.[46] This represents 'the most dangerous threat both regionally and inter-regionally' in the near future.

Can Al Qaida Acquire Nuclear Capabilities?

Any comprehensive analysis of the possibilities for terrorist groups to acquire or develop and deploy nuclear weapons essentially begins with

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41 'National Counterterrorism Center: Annex of Statistical Information', *Country Reports onTerrorism 2011*, July 2012 at http://www.potomacinstitute.org/attachments/article/1358/Terrorism%20in%20North%20Africa%20&%20the%20Sahel.pdf p.3.

42 Ibid.

43 Ibid.

44 United States Department of State, 'Country Reports on Terrorism 2007', United States Department of State Publication Office of the Coordinator for Counterterrorism, April 2008, p.7 at http://www.state.gov/documents/organisation/105904.pdf (Accessed June 1, 2008).

45 Robin M. Frost, 'Nuclear Terrorism After 9/11', *Adelphi Paper 378,* The International Institute for Strategic Studies, Routledge 2005, p.55.

46 Yonah Alexander, 'Terrorism in North Africa & the Sahel in 2012: Global Reach & Implications', *Potomac Institute For Policy Studies*, February 2013, p.9 at http://www.potomacinstitute.org/attachments/article/1358/Terrorism%20in%20North%20Africa%20&%20the%20Sahel.pdf.

certain technical questions. Can the terrorist organisation successfully get hold of weapons-grade materials? Have they gained mastery over the relevant technical and scientific competence to build a nuclear device? Do they have the essential delivery vehicles to launch them? The exemplar of states like Iraq, Libya and Syria with a record of unsuccessful attempts to acquire nuclear weapon technology is often cited as a confirmation of the problems entailing the building and developing nuclear weapons technical capabilities. 'Significant technical hurdles stand in the way of practicing nuclear terrorism in any form.'[47]

Al Qaida can obtain nuclear weapons or materials by stealing or purchasing assembled nuclear weapons from any state with negligent security of its nuclear weapon stockpile. Alternatively, they can attempt to fabricate a bomb.[48] Seemingly, Al Qaida would prefer the latter option since it is less complicated to obtain fissile material than to get a whole nuclear bomb. In a survey conducted by Senator Richard G. Lugar, 63 of the 83 respondents selected 'black market purchase' as the most likely means from where terrorists might obtain fissile material.[49] 55 per cent of those responding[50] saw terrorist manufacture of a nuclear weapon after obtaining material as more likely, while 45 per cent believed that terrorist acquisition of a working nuclear weapon was the more probable scenario.[51] In a survey conducted by the author, the opinion is equally divided. The respondents believed that the possibility of terrorists' access to nuclear weapons is possible vide the nuclear black market as well as through acquisition.[52]

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47 Gavin Cameron, no. 1.

48 'The Nth Country experiment showed that three post-docs with no nuclear knowledge could design a working atom bomb'. Dan Stober, 'No Experience Necessary', *Bulletin of Atomic Scientists*, March/April 2003, pp. 57-63.

49 Senator Richard G. Lugar, 'The Lugar Survey Proliferation Threats and Responses', Washington, DC, June 2005, p.16.

50 45 out of 82 respondents. Ibid.

51 Ibid., p.17.

52 Survey conducted by means of a questionnaire on nuclear terrorism that was circulated to experts based all over India. Names of the experts cannot be disclosed due to organisational restraints. For details see Reshmi Kazi, 'The Danger of Nuclear Terrorism: The Indian Case', *Strategic Analyses*, Vol 33 Issue: 4, July 2009.

There are many examples of diversion of fissile materials from inadequately safeguarded nuclear reactors. The International Atomic Energy Agency (IAEA) and Illicit Trafficking Database (ITDB) reports 103 confirmed incidents of illicit trafficking and other unauthorised activities involving nuclear and radioactive materials in 2005.[53] Reports confirm another 57 incidents of illicit trafficking from previous years with most occurring mainly in 2004. From 1993 to 2005, there were 18 confirmed incidents that involved trafficking in or loss of Highly Enriched Uranium (HEU) and plutonium.[54] In February 2007, IAEA reported 149 confirmed incidents of illicit trafficking and other unauthorised activities involving nuclear and radioactive materials in 2006.[55] Of these, 15 involved the seizure of nuclear and radioactive materials from individuals who possessed them illegally, according to preliminary figures released by the IAEA Office of Nuclear Security.[56] 'Six of these incidents involved nuclear materials. Five involved materials such as natural uranium, depleted uranium, and thorium and one involved HEU.'[57] Recent reports from the IAEA indicate that there were 243 incidents of missing or illegally trafficked nuclear material between June 2007 and June 2008.[58]

Crude Nuclear Weapons

If Al Qaida obtains the relevant fissile material, does it have the preferred technical competence to build a nuclear device? Argumentatively, all nuclear weapon states have devoted several years of effort and 'large

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53 'IAEA releases latest Illicit Trafficking Database statistics', at http://un.by/en/news/world/2006/28-08-06-13.html (Accessed June 16, 2008).

54 Ibid. A few of these incidents involved seizures of kilogram quantities of weapons-usable nuclear material, but most involved very small quantities.

55 'UN atomic watchdog agency reports cases of illegal trafficking in nuclear materials', *UN News Centre*, at http://www.un.org/apps/news/story.asp?NewsID=21409&Cr=nuclear&Cr1=iaea (Accessed June 16, 2008).

56 This is not to say that all the diverted material has been appropriated by Al Qaida but it can be presumed that they have been a major client seeking fissile materials.

57 The IAEA statement of the incidents, which were reported by the states involved with the Office's Illicit Trafficking Database (ITDB), UN News Centre at http://www.un.org/apps/news/story.asp?NewsID=21409&Cr=nuclear&Cr1=iaea (Accessed June 16, 2008).

58 'Keeping tabs on nuclear material', *International Herald Tribune*, November 2, 2008.

design teams and resources to the development of nuclear weapons' to develop their nuclear weapons programmes. It is noteworthy that most of these resources have been put to use for the production of fissile materials.[59] States generally aim to produce a sophisticated weapons line including their own capacity to enrich fissile material. Hence, the technical challenges involved are significantly considerable. However, these technical challenges can be evaded simply by trying to manufacture crude nuclear weapons that do not require extensive knowledge. In all probability, Al Qaida leaders would prefer a crude nuclear device to overcome the technical difficulties involved in building traditional state-of-the-art nuclear weapons.

There are essentially two design types of nuclear weapons which are expected to satisfy the purposes of outfits like Al Qaida. First, is a 'gun-type' bomb – the simplest nuclear bomb for terrorists to design from only HEU.[60] In most cases, making such a bomb would require some ability to cast machine uranium, reasonable knowledge of the nuclear physics involved, and a good understanding of cannons and ballistics.[61] In many cases, an ability to undertake some chemical processing might be necessary; but the chemical processing required is less sophisticated than some of the processing criminals routinely undertake in the illegal drug industry.[62] The second design type constitutes

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59 D. MacKenzie and G. Sinardi, 'Tacit knowledge, weapons design and the uninvention of nuclear weapons', *American Journal of Sociology*, 101 (1), July 1995.

60 It involves little more than slamming two pieces of HEU together at high speed and can produce a powerful explosion. See Luis Alvarez, *The Adventures of a Physicist,* Basic Books, New York, 1987.

61 For discussion, see Bunn and Wier, 'Terrorist Nuclear Weapon Construction', J. Carson Mark *et al*., 'Can Terrorists Build Nuclear Weapons?', in Paul Leventhal and Yonah Alexander (ed.), *Preventing Nuclear Terrorism*, Lexington Books, Lexington, MA., 1987 at http://www.nci.org/k-m/ makeab.htm (Accessed August 7, 2007).

62 James C. Warf, one of the leaders of the chemical processing programs in the Manhattan Project, has argued that the steps needed to get HEU from research reactor fuel in which it is mixed with other materials 'are not difficult procedures, particularly for someone intent on acquiring an atomic explosive; one might say, in fact, that they are not beyond the ability of most students in introductory chemistry classes at the college level'. See Committee on Science, Space, and Technology, 'Conversion of Research and Test Reactors to Low-Enriched Uranium (LEU) Fuel', U.S. Congress, House of Representatives, 98th Congress, 2nd Session, September 25, 1984, pp. 514-516.

the 'implosion type' device. This is a more challenging process in which explosives positioned around the fissile material condenses it to a much higher density, setting off a nuclear chain reaction. The yield is much higher in the implosion type device. While the probability of terrorists seeking to fabricate an implosion type weapons-grade nuclear device is quite less, the threat cannot be completely disregarded. Hence, 'theft of separated plutonium, whether weapons-grade or reactor-grade, would pose a grave security risk.'[63] In this context, within South Asia, Pakistan's uranium-based nuclear weapons programme, (India's nuclear weapons programme is plutonium-based) projects major worries. The relatively huge stockpile of HEU within Pakistan poses fears that are no longer imaginary. The prevailing political disturbance shouldered by a not yet fully consolidated government heightens the risks of terrorists gaining access to Pakistan's HEU stockpile. This in turn increases the threat of nuclear terrorism in South Asia.

To what extend can a crude HEU-based nuclear device serve the requirements of Al Qaida? A home-produced nuclear weapon would be considerably less capable than the usual state-of-the-art nuclear weapons. The yield of a crude nuclear device would be much lesser than a sophisticated nuclear weapon. However, most terrorists would be satisfied with a large, cumbersome, unsafe, unreliable, unpredictable and inefficient device.[64] This is primarily because the vital consideration for nuclear weapon states would be more about the safety of 'nuclear devices not going off during storage and transportation as with optimising the yield and detonation of the weapon.'[65] However, such concerns will be less inspected by terrorist organisations who have a penchant for martyrdom. Second, presumably a crude nuclear bomb would be adequate for apocalyptic results because the reliability of crude nuclear weapons would not be an impinging issue for them.

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63 U.S. Department of Energy, Office of Arms Control and Nonproliferation, *Nonproliferation and Arms Control Assessment of Weapons-Usable Fissile Material Storage and Excess Plutonium Disposition Alternatives*, DOE/NN-0007, DOE, Washington, D.C., 1997 at http:// www.osti.gov/bridge/servlets/purl/425259-CXr7Qn/ webviewable/ 425259.pdf, pp. 37-39 (Accessed January 2, 2007).

64 Graham Allison, no.11, p. 97.

65 Morten Bremer Mærli, Annette Schaper and Frank Barnaby, 'The Characteristics of Nuclear Terrorist Weapons', *American Behavioral Scientist*, 46 (6), February 2003, p.732.

Although an ignition failure or a fizzle yield would be disadvantageous for Al Qaida, yet it would still be an offensive attack on the security system of any state. This laxity in safety will not be acceptable to nuclear weapon states. They would opt for 'fairly predictable and accurate yields', which increase the degree of technical sophistication. For terrorists however, any explosion in the lower kiloton range represents an unprecedented yield.[66] Moreover, 'fizzling plutonium weapons' can be used as potential radiological dispersal devices. Third, crude nuclear bombs unlike conventional state-of-the-art nuclear weapons will not essentially need sophisticated delivery launch pads (missiles, mortars). Crude nuclear bombs can be easily transported in an automobile or van for subsequent detonation in the target area. Other delivery means can include trucks, hot-air balloons, ships and deserted out-of-the-way residences where a crude nuclear device can be assembled.

Nuclear physicist, Theodore Taylor, who designed America's smallest as well as largest atomic bombs, has repeatedly expressed the opinion that given fissile material, building a bomb is '…very easy. Double underline. Very easy.'[67] A significant question that arises here is how easy is it for Al Qaida to obtain weapons-grade nuclear material?

HEU: The Line of Least Nuclear Terrorist Resistance[68]

Of the two weapons designs, terrorists with access to HEU, crude nuclear explosives of a gun-type design are likely to represent the line of least resistance to the nuclear ambitions.[69] There are numerous reasons for this. For example it is less complicated to handle HEU than plutonium since the former is less radioactive. Hence, it is simpler to design a fairly reliable crude nuclear explosive in the lower kiloton range (a comparable Hiroshima type bomb) with HEU than plutonium. HEU crude devices might be of greater interest to terrorists because

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66 Ibid.

67 Dan Stober, no.13, p.57-63.

68 Morten Bremer Maerli, *Atomterrorisme* (*Atomic Terrorism*, in Norwegian), Norwegian Institute of International Affairs, Oslo,1999, p.14.

69 'Crude' here essentially means technically unsophisticated nuclear explosive devices. Ibid. p.20.

of their low detection level. Generally, it is easier to detect plutonium devices than uranium devices, due to higher radiation levels.[70] With emerging concerns of Al Qaida in quest of nuclear explosives and materials, sophisticated radiation detection sensors have been deployed along the borders, overseas facilities and points around Washington DC. The ability of these sensors to detect nuclear material, however, may be limited.[71] Weak gamma ray radiation from the crude device makes detection almost impossible and thus heightens its mobility from place to place. These reasons obviously make HEU an attractive option for terrorist organisations like Al Qaida. Hence for purpose of this study, HEU has been considered to be more appropriate than plutonium to serve the goals of terrorists seeking nuclear explosives or devices for acts of terror.

Motivation for the Use of Nuclear Explosives

Since the last decade there has been a dramatic transformation in the nature of international terrorism. It has become more lethal and violent. In the past, many terrorist organisations indicated their predilection for using the nuclear option but were in general more conservative in their degree of violence and strategies. However, newer terrorist outfits are more sophisticated, innovative and willing to use novel weapons to inflict mass casualties. Violence is the trait that sets the group apart. It gives the organisation its identity, so any attempt to alter that is extremely difficult.[72] The motivation for violent terrorist groups to seek and acquire weapons of mass destruction is a complex affair and happens in a dynamic and evolving circumstance. It does not occur in one day. What are the driving factors that will motivate Al Qaida to use nuclear explosives or devices on its chosen targets?

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[70] Gunnar Arbman, Anders Axelsson, Ronny Bergman, Lena Melin, Andres Ringbom, Lena Oliver, LennartWidlund, Lars Wigg & GöranÅgren, PrimitivaKärnladdninger – ettrealistisk hot? (Crude Explosive Devices – A Real Threat?, in Swedish),FOI-R-0735-SE, Totalförsvaretsforskningsinstitut, December 2002 p.7 as stated in Morten BremerMaerli, *Atomterrorisme,Atomic Terrorism*, in Norwegian),Norwegian Institute of International Affairs, Oslo,1999, p.72.

[71] James Glanz, , 'Despite New Tools, Detecting Nuclear Material Is Doubtful', *New York Times,* March, 18, 2002.

[72] Gavin Cameron, *Nuclear Terrorism: A threat Assessment for the 21st Century,* Great Britain: Macmillan Press Ltd,Great Britain, p.14.

Nuclear weapons are a new technology, unforeseen by Prophet Muhammad and unspecified in the Koran. Yet, senior Al Qaida leaders have reasoned the cataclysmic utility of force to spread the word of Allah, notwithstanding the misinterpretations of the various traditions and the scriptures of Islam. Their ideology and rationales in the form of fatwas and treatises easily available on the electronic media and in print 'tell a fascinating but disturbing story'. Based on these misinterpretations, Al Qaida leaders have justified mass killings. Al Zawahiri's justification of the 7/7 attacks opines, 'You [US] made rivers of blood in our countries, so we blew up volcanoes of rage in yours.'[73] Violence deserves violence, Al Zawahiri has said, in line with Al Qaida's assertion of the necessity of reciprocal justice.[74] Al Qaida has also justified the trend of suicide bombing – an act that is strictly forbidden under the Sharia law. Senior Al Qaida leaders have suitably misinterpreted the Sharia and inculcated young minds with misperceptions about jihad and martyrdom. Unfortunately, Al Qaida has been quite successful in its efforts as is evident from the series of suicide bombings.[75] From January-April 2008, there have been 19 suicide attacks in Pakistan, killing 274 security officials and injuring many more.[76] This strategy fulfills a dual purpose for Al Qaida:

- signalling to the targets (particularly the West) to accept their demands (US Marines withdrew from Lebanon after the 1983 bombing of the barracks);
- suicide bombers serve as delivery tools and subsequent launch pads for detonation of nuclear devices.

It can be thus deduced that the ideology of a terrorist groups is a significant factor that shapes its motivation to resort to the nuclear

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[73] See David Bukay, 'The Religious Foundations of Suicide Bombings:Islamist Ideology',*Middle East Quarterly*,12006,13(4), pp. 27-36.

[74] John Kelsay, *Arguing the Just War in Islam* Harvard University Press, Massachusetts, 2007, p. 204.

[75] Ahmed Rashid, 'Jihadi Suicide Bombers: The new Wave', *The New York Review of Books*, 55 (10), June 12, 2008 at http://wwwnybooks.com/articles/21473 (Accessed June 13, 2008).

[76] Ibid.

option. It primarily convinces the terrorist that what he is doing is right and justified. In the case of Al Qaida, their ideology is influenced by the belief that the infidels have corrupted the world with their policies and with the secular ideologies of the West like capitalism, communism, atheism, modernism and materialism. It is hence, the responsibility of the terrorists to declare jihad against the non-believers and eliminate them so as to purge the world from these wrong doers. This has gone to the extent that violent terrorist groups are absolutely convinced that they are doing God's bidding, and virtually, any action they decide to undertake can be justified, no matter how heinous, since the 'divine' ends are thought to justify the means.[77] This reasoning is a pointer that religiously inspired terrorism can motivate the apocalyptic terrorists groups to use nuclear explosives and devices for causing violent casualties. Second, terrorists would be motivated to use nuclear devices primarily because within the category of WMD, nuclear weapons are the most lethal and can cause mass casualties and massive physical damage. Another factor that would strongly motivate groups like the Al Qaida to use nuclear devices is that they can fulfill their desire to exert extreme psychological impact on the target audience and their supporters that will leave them terror struck forever. In that sense, nuclear weapons are ideally suited for terrorism, since their employment is almost guaranteed to exert a disproportionate impact upon the emotional states of the wider audiences that terrorists are by definition trying to influence or traumatise with their acts of violence.[78]

Revenge is yet another factor that can enormously motivate apocalyptic terrorist groups to choose the nuclear path. In the aftermath of the US efforts to destabilize the Al Qaida in Afghanistan, the ideological themes of revenge and identity became dominant in the thought process of the Al Qaida. The main strategy of the Al Qaida, it is believed, is to use nuclear weapons to neutralise and destroy the West and its partners and allies for revenge. This thinking deeply influences and emphasises the Islamist identity to persevere towards the destruction of the enemy

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[77] Jeffrey M. Bale, Islamism, in Richard F. Pilch and Raymond Zilinskas (eds.), *Encyclopedia of Bioterrorism Defence* Wiley, New York 2005, pp. 296-298.

[78] Jonathan B. Tucker and Amy Sands, 'An Unlikely Threat', *Bulletin of the Atomic Scientists*, 55 (4) July- August 1999, p. 49.

(the western world) and in fulfilling these goals, nuclear weapons are considered by the terrorists to be the most appropriate.

Global stockpiles of nuclear weapons and the materials

A cardinal facet of the peril of nuclear terrorism is the large volume and expansive distribution of the global stockpiles of nuclear weapons and fissile materials required to build nuclear weapons. More than twenty years since the end of the Cold War, the total world nuclear inventory consists of approximately 19000 nuclear warheads.[79] All the countries possessing nuclear weapons are known to be further modernising their arsenal. As of January 2013, the global stockpile of HEU is estimated to be about 1390 tonnes.[80] The global stockpile of separated plutonium is about 490 tonnes, of which about 260 tonnes is the material in civilian custody.[81] The US and Russia still retain a stockpile of over 18,000 nuclear weapons.[82] In addition, there are still over one hundred research reactors worldwide that use HEU today, some of which contain large quantities of weapon-grade material (90–93 per cent U-235).[83] Pakistan is constructing its second and third plutonium production reactors, which are expected to triple its annual weapons-grade plutonium production. Pakistan and India are also producing weapons grade uranium for weapons and naval-reactor fuel respectively. At the end of 2011, India's HEU stockpile was estimated to be 2.0 ± 0.8 tons.[84] It is estimated that, as of 2011, Pakistan could have a stockpile

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79 This figure includes operational warheads and warheads awaiting dismantlement, with the United States and Russia together holding over 18,000 of these weapons and the other seven nuclear-weapon states holding a combined total of about 1000 weapons. See 'Global Fissile Material Report 2011: Nuclear Weapon and Fissile Material Stockpiles and Production', *Sixth Annual Report of the International Panel on Fissile Materials* at http://fissilematerials.org/library/gfmr11.pdf p. 2, (Accessed on July 5, 2013).

80 "Fissile material stocks," *International Panel on Fissile Materials*, March 11, 2013 at http://fissilematerials.org/ (Accessed on July 5, 2013).

81 Ibid.

82 'Global Fissile Material Report 2011: Nuclear Weapon and Fissile Material Stockpiles and Production', *Sixth annual report of the International Panel on Fissile Materials* at http://fissilematerials.org/library/gfmr11.pdf p. 2 (Accessed on July 5, 2013).

83 Ibid. p. 11.

84 Ibid. p.10.

of about 2.75 ± 1 tons of weapon-grade (90 per cent enriched) HEU.[85] Pakistan is also reported to have developed much advanced centrifuge technology (P-3 and P-4).

The security of the widespread distribution of global stockpile necessities differs from exceptional to abysmal levels. Hence, extensive measures are mandatory to safeguard them from any damage. However, some nuclear stockpiles are dangerously insecure.[86] It is obvious that Al Qaida will basically pursue the *Willie Sutton principle* in their quest for fissile materials for a nuclear device and will focus on those poorly safeguarded sites where fissile material is vulnerable and thus, simplest to steal or can be purchased from some middleman inclined to peddle. Most of the nuclear facilities in the world, including several in the US, are not capable enough to provide an unfailing defence against attacks as large as those that terrorists have already proved they can mount, such as by those who struck on September 11, 2001, or by those who seized a thousand hostages at the school in Beslan, Russia in September 2004.[87] Circumstances that are more arduous can result if a plot by insiders, possibly intimidated by terrorists, is not revealed and thwarted in time. Although, considerable attempts have been made to support Russia's nuclear security, it nonetheless presents critical perils of nuclear theft for the world. In February 2006, Russian citizen Oleg Khinsagov was arrested in Georgia (along with three Georgian accomplices) with about 100 grams of HEU enriched to 89 per cent U-235.[88] In November 2007, four armed men broke into the Pelindaba nuclear facility in Pretoria, a site where an estimated 25 bombs' worth of weapons grade uranium is stored.[89] These four 'technically sophisticated criminals'

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85 Ibid. p.11.

86 Matthew Bunn, 'Securing the Bomb 2007', Belfer Center for Science and International Affairs,September 2007, p.13.

87 Ibid.

88 Elena Sokova, William C. Potter, and Cristina Chuen, 'Recent Weapons Grade Uranium Smuggling Case: Nuclear Materials Are Still on the Loose', Centre for Nonproliferation Studies, Monterey Institute of International Studies, January 26, 2007 at http://cns.miis.edu/pubs/week/070126.htm(Accessed July9, 2007).

89 The Pelindaba nuclear facility is one of South Africa's most heavily guarded 'national key points' — defined by the government as 'any place or area that is so important that its loss, damage, disruption or immobilisation may prejudice the Republic'. See Micah Zenko, 'A Nuclear Site is Breached', *Washington Post*, December 20, 2007, p. A 29.

deactivated several layers of security, including a 10,000-volt electrical fence, suggesting intricate knowledge of the system by an insider.[90] What merits grave notice is, if the armed perpetrators had succeeded in penetrating the site's HEU vault, they could have lugged away the materials for the world's first terrorist nuclear explosive. This case is a single indicator to the significance of advancements in the physical protection of nuclear facilities. The recent mortar attack by Baloch rebels on a Pakistani nuclear establishment near Dera Gazi Khan reinstated the long perceived threat to nuclear installations by non-state actors.[91]

Danger of Nuclear Terrorism in India: Survey Findings

In the survey carried by the author, approximately 80 per cent of the respondents opined that nuclear terrorism is a plausible reality,[92] but there is obscurity on the probability of the nuclear threat in India. It is predominantly limited to the 'culture of secrecy' eschewing any public debate on the concern. This state of affairs needs an appraisal.

The survey conducted by the author showed that the threats of nuclear terrorism *ipso facto* result from the predominating political volatility in Pakistan and Afghanistan that makes them susceptible areas for terrorists to procure nuclear/radiological weapons and/or materials. The risks are also rooted in the likelihood of new states joining the nuclear club and the nuclear weapon states increasing their nuclear arsenal. The growing India-US strategic partnership has further amplified the threat from Al Qaida, which has announced jihad against the US and its partners. In December 1999, Nazeer Ahmed Mujjaid, the military advisor of Al Qaida, in a fax message to the *Voice of America* in Washington, proclaimed that the goal of these groups is to fight against

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90 Micah Zenko, Ibid.

91 'Mortar attack on Pak N-Facility', *Rediff.com,* May 17, 2003.

92 Most of the respondents believe that with the rapid globalisation of technology, increased access to relevant information and societal transformation, the probability of terrorists accessing sensitive material and technology has increased.

'Americans, Russians and Indians'.[93] In April 2006, during President Bush's visit to South Asia, Bin Laden projected a global jihad against the 'anti-Islam conspiracy of the Crusaders (Christians), the Jewish people and the Hindus'.[94] Al Qaida's name floated in the Indian media in the aftermath of the Godhra carnage in Gujarat. Concerns about a probable lethal attack upon India by Al Qaida are feared in the Western world as well. According to Christine Fair, 'We have concerns about them attacking India because that's the most likely way that we are going to get an India-Pakistan crisis.'[95] With the death of Osama bin Laden, it is assumed that the terrorist organisation has been debilitated. There is no credible substantiation to support the claim that post bin Laden there exist lesser terrorist groups aiming attacks at the US and its allies including India.

It has been argued that Al Qaida has suffered a 'strategic defeat' and no longer possesses the capability to strike its targets on a mass scale.[96]However, it would be imprudent to make such an assessment since the organisation operates through 'sleeping cells' that are dispersed all over the world. A recent BBC opinion poll revealed that the Al Qaida has not weakened as an organisation and efforts to tackle it have been so far unsuccessful.[97]According to the International Center for Terrorism Studies, radical extremist groups are 'nourished by Al-Qaida's radical theology of jihad and sustained by loose and at times more structured networks, based on organizational and operational collaboration.'[98] The Al Qaida may have been incapacitated but it has

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93 See B. Raman, 'Al Qaeda's Shadow Over India', *International Terrorism Monitor*, Paper no. 242, South Asia Analysis Group, at http://www.saag.org/paper23/paper2267.html (Accessed June 13, 2008).

94 Ibid.

95 Ben Arnoldy, 'With Al Qaeda weakened, US warns about other Pakistani terror groups', *Christian Science Monitor*, May 19, 2011 at http://www.csmonitor.com/World/Asia-South-Central/2011/0519/With-Al-Qaeda-weakened-US-warns-about-other-Pakistani-terror-groups (Accessed March 15, 2012).

96 Joby Warrick, 'U.S. Cites Big Gains Against Al-Qaeda', *Washington Post*, May 30, 2008, p. A 01.

97 'Al Qaeda not weakening – BBC poll', BBC News, September 29, 2008 at http://news.bbc.co.uk/2/hi/americas/7638566.stm (Accessed September 30, 2008).

98 Yonah Alexander, "Terrorism in North Africa & the Sahel in 2012: Global Reach & Implications," Potomac Institute For Policy Studies, February 2013, p.9.

not yet been overpowered. Over the last three years, while their policy of targeted killings has been implemented, Al Qaida in the Arabian Peninsula (AQAP) has emerged as the most lethal of the terrorist network's franchises.[99] At the rate Al Qaida has been adapting, it seems likely that the US will be at war with this enemy for another decade.[100] Within South Asia, the situation has become further complex with the existence and active functioning of various extremist groups like Jaish-e-Mohammed, Lashkar-e-Toiba and Harkat-ul-Jehad-al-Islami in the sub-continent. These extremist organisations are deeply influenced by the Al Qaida led pan-global jihad union and share a mutual ideology. The enormity of the difficulty warrants grave deliberation since Al Qaida is willing to acquire nuclear/radiological materials and weapons and has touched base with several individuals and Islamist terrorist groups to obtain these sensitive technologies and weapons-grade materials.

The dread of nuclear terrorism is further bolstered with the reported incidents of illicit trafficking of nuclear materials both in India and elsewhere in the sub-continent. Since 1993, nine trafficking cases involving uranium ore and LEU (low-enriched uranium) have been recorded in India, one in Bangladesh and another in Pakistan.[101] Most of the fissile material seized from India is from the local facilities. For example, in April 2005, uranium was seized from Assam, stolen by two men from a government facility from Shillong.[102] In October 1994, four Indian villagers were arrested in the West Khasi Hills district of Meghalaya while trying to sell 2.5 kg of natural uranium (yellowcake).[103] In July 1998, the CBI was reported to have unearthed a uranium theft racket when it seized six kg of uranium and arrested two persons,[104]

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99 Christopher Heffelfinger, 'Mission Not Accomplished: Reports of al Qaeda's demise have been greatly exaggerated', *Foreign Policy*, August 5, 2011 at http://www.foreign policy.com/articles/2011/08/05/mission_not_accomplished? page=0,1(Accessed March 115, 2012).

100 Ibid.

101 See *Nuclear Black Markets: Pakistan, Khan and the rise of proliferation networks,* International Institute for Strategic Studies, 2007, p.130.

102 'Uranium Sting Nets 2 in India', UPI,April 11, 2005.

103 'India: Smugglers Caught', *Nucleonics Week*, November 3, 1994.

104 'CBI to go Ahead with Uranium Theft Case Probe', *The Indian Express,* July 30, 1998.

while in August 2001, Indian security forces seized 225 kg of yellowcake en route to Bangladesh.[105] In January 2011, 15 disused Cobalt-60 isotopes were stolen from the storage room near the Research and Control Laboratory building of the state-run Steel Authority of India Limited's (SAIL) Durgapur plant.[106]

However, before making any hysterical conclusion, one must know that yellow cake and LEU are not weapon-usable without undergoing enrichment, which itself is an extremely complicated process. Moreover, most of this information is primarily compiled from newspapers and therefore, lacks adequate credibility. Nevertheless, what deserves attention is that proliferation of fissile material will remain a problem in the long-term as indicated in the *Asia Pacific Security Survey 2007 Report*.[107] A recent report jointly prepared by the British Royal United Services Institute and the Observer Research Foundation in New Delhi has analysed the probability of extremist organisations of acquiring WMD materials from inadequately safeguarded sources in India.[108] It is important to step up the vigilance to thwart any attempts by terrorists to unleash terror in India or in the sub-continent.

The situation in India also points to collusions between the LeT, JeM and Al Qaida. In early September 2008, at the Border Security Force (BSF) control room in R.S. Pura sector, footage showing black spots on the TV screen, each representing a militant moving surreptitiously along the International border in Jammu and Kashmir was accessed.[109]

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105 'Uranium Seized', *The Statesman* , August 25, 2001.

106 '15 disused Cobalt-60 isotopes stolen from SAIL in Jan', The Economic Times, March 14, 2011 at http://articles.economictimes.indiatimes.com/2011-03-14/news/28688413_1_cobalt-60-isotopes-cesium-137 (accessed on January 5, 2012).

107 Jim Rolfe, 'Asia Pacific Security Survey Report', East-West Center, Honolulu: 2007 at http://scholarspace.manoa.hawaii.edu/bitstream/handle/10125/3974/APSS2007.pdf?sequence=*1* (Accessed June 27, 2007).

108 Rajeswari Pillai Rajagopalan (et.al.), 'Chemical, Biological and Radiological Materials: An Analysis of Security Risks and Terrorist Threats to India', *Observer Research Foundation*, 2012 at http://www.observerindia.com/cms/export/orfonline/documents/ORF-RUSI.pdf p.

109 The build up, monitored constantly with intelligence inputs revealed that at least 500 terrorists were hiding along the border plotting to strike. For the first time, *Times Now* managed to access thermal images of the militant build up, which provided more proof of Pakistan's constant provocation. 'Proof of terrorist build-up along J&K border', *The Times of India*, September 3, 2008.

Although these militants could not be alleged to be Al Qaida terrorists, the bombs used in the Surat and Bangalore blasts in July-August 2008 were believed to be the actions of the Al Qaida cadre,[110] and intelligence reports indicated the gravity of the threat situation.

Preceding the catastrophic September 2001 incident, India or Kashmir hardly featured in Al Qaida's statements. Al Qaida's primary target was America and the rest of the Western world. Interestingly, post 9/11 and particularly with emerging India-US strategic ties culminating in the US-India Civil Nuclear Energy Cooperative Initiative, Al Qaida perceives India as a close ally of the US. Al Qaida's list of enemies includes not only America but also its strategic partners as well. Following the India-US civil nuclear energy deal, references of threats to India have been more frequent. The US support to India on the Kashmir issue and India's growing ties with Israel have fanned anti-India feelings within the Al Qaida. In an audio message disseminated in April 2006 in the wake of the visit of President George Bush to Afghanistan, India and Pakistan in March 2006, bin Laden projected the global jihad as directed against what he described as the joint anti-Islam conspiracy of the Crusaders (Christians), the Jewish people and the Hindus.[111] Previously, he had never referred to Hinduism as part of this global conspiracy.[112] A report by the United States Department of Defence (DoD) submitted to Congress in early November 2011, suggested that India is the 'primary target' of LeT, the militant group from Pakistan that is held responsible for the 2008 Mumbai attacks.[113] In the vital area of counterterrorism cooperation, the DoD report noted that LeT's activities 'continue to threaten US interests and South Asian regional stability', and hence the US would join with key partners such as India, 'to expand counterterrorism cooperation... and our current special

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110 Vishwa Mohan, 'Al Qaeda tech used in Bangalore, Surat Bombs', *The Times of India*, July 31, 2008.

111 B. Raman, 'Al Qaeda's Shadow over India? *South Asia Analysis Group*, International Terrorism Monitor—Paper no. 242, June 14, 2007 at http://www.southasiaanalysis.org/%5Cpapers23%5Cpaper2267.html (Accessed April 3, 2012).

112 Ibid.

113 Narayan Lakshman, 'For LeT, India remains the "primary target": US', *The Hindu*, November 2, 2011 *at http://www.thehindu.com/news/international/article2592015.ece (*Accessed April 6, 2012).

operations engagements in the region will continue to focus on the mutually beneficial ways in which we can enhance each other's capabilities.'[114]

Security Structure of the Indian Nuclear Establishment

India's nuclear establishment is elaborate with sophisticated safety and security measures in place.[115] However, considerable measures still need to be undertaken to bolster its safety. Though the Central Industry Security Force (CISF) is responsible for safeguarding India's nuclear installations, it is 'overburdened with additional responsibilities'[116] and 'stretched too thin'.[117] The government's official web-site recognises 'CISF is increasingly being called upon to perform important duties beyond its charter such as internal security, airport security and security of highways, election duty, etc.' It also protects steel plants, oil refineries, ports and airports and many vital installations. The CISF web site states that its seven training institutions are 'trying to keep the force abreast of the latest trends in threat perception and its management *vis-à-vis* the technological advancement in the field.'[118] Perhaps this accounts for the major security failure involving one or more insiders in the theft of as many as 29 aluminum alloy titanium rings (used in rocket engines) from the high-security ISRO's Liquid Propulsion Systems Centre (LPSC) in Bangalore in February 2004.[119] There have been other organisational failures that raise concerns about India's nuclear establishment. In October 2003, a major security breach occurred when 18 to 20

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[114] Ibid.

[115] The Department of Atomic Energy proclaims that the safety mechanism of 'radiation protection infrastructure in India is on very sound footing and is constantly being strengthened'. See 'Success Stories – Radiation Protection', at http://www.barc.ernet.in/rcaindia/4_7.html.

[116] Charles D. Ferguson, 'Assessing the Vulnerability of the Indian Civilian Nuclear Programme to Military and Terrorist Attack', in Henry Sokolski, (ed.), *Gauging US-Indian Strategic Cooperation*, March 2007, at http://www.npec-web.org?Essays/20060913-Ferguson-AttacksOnFacilities.pdf (Accessed May 23, 2008).

[117] Rajesh M. Basrur and Hasan-Askari Rizvi, 'Nuclear Terrorism and South Asia: Cooperative Monitoring', Center Occasional Paper no. 25, Sandia National Laboratories, SAND 98-0505/February 25, 2003.

[118] See http:cisf.nic.in/

[119] 'Titanium Rings Stolen from ISRO', *Deccan Herald*, February 14, 2004.

computers containing highly classified data, including communication codes vital for ensuring secrecy of intra-governmental communications, were stolen from a Delhi office of the DRDO, an integral part of the nuclear-weapons establishment.[120] The codes remained unchanged for nearly nine months after the incident. In September 2004, a senior scientist at the Remote Sensing Applications Centre (RSAC) in Lucknow was arrested along with his wife, a former employee at the Centre, for selling classified satellite pictures and data.[121] Nuclear facilities also face vulnerabilities from cyber-security and insider threats as well. There remain uncertainties about the probable effects of a chartered aircraft loaded with high explosives crashing into a 'typical Indian reactor building'. Though, the CANada Deuterium Uranium (CANDU)-type reactors like the pressurised heavy water reactors (PHWRs) have certain safety measures that protect them against sabotage[122], its spent fuel pool is outside the containment building and hence is more vulnerable to sabotage than the boiling water reactor. The two Vodo-Vodyanoi Energetichesky Reactor (VVER)-1000 type plants being built by Russia in Koodankulam, Tamil Nadu may be also inherently vulnerable to an airliner crashing into it like the World Trade Centre (WTC) attack.[123] There are infrastructural weaknesses within existing plants of this type creating vulnerability to a single blast.[124] The containment structures of long-standing commercial reactors like Tarapur are not as vigorous as those of modern reactors. Hence, it remains a matter of debate whether they can withstand a large airplane crash like the one on the WTC.

It is fairly well known that India's nuclear establishment has some of the finest safety and security measures for safeguarding its nuclear

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120 Lalit Kumar and Rajat Pandit, 'Secret Military Codes Stolen from DRDO', *The Times of India*, June 3, 2004.

121 Aman Sharma, 'Scientist Couple Held for Selling Data', *Indian Express*, September 25, 2004.

122 The containment buildings of the CANDU-type reactors have approximately four foot thick concrete walls built around the main reactors.

123 Rajesh M. Basrur and Friedrich Steinhausler, 'Nuclear Terrorism and Radiological Terrorism Threats for India: Risk Potential and Countermeasures', at http://jps.lanl.gov/vol1_iss1/3-Threats_for_India.pdf (Accessed March 22, 2008).

124 Helmut Hirsch, 'Vulnerability of VVER-1000 Nuclear Power Plants to Passenger Aircraft Crash', WISE, November 2001 at http://www.antenna.nl/wise/terrorism/112001vver.html (Accessed January 23, 2008).

facilities. Every nuclear power plant is surrounded by a double-layer security arrangement with a distance of 1.5 km of Sterilised Zone from the nuclear facility deployed with sophisticated surveillance systems. Habitation is restricted in the sterilised zone, which expands up to five km. The sterilised zone is again surrounded by an Emergency Planning Zone (EPZ) extending up to 16 km. The Nuclear Power Corporation India Ltd. (NPCIL) is a member of the World Association of Nuclear Operators (WANO) that conducts peer reviews of all the atomic power stations progressively. But the security is not absolute in any measure. Hence, periodic assessment must be done of the inbuilt safety mechanism in the nuclear installations and strict implementation of the personnel reliability programme is important especially in view of the internal-sabotage risk factor. When it comes to the protection of India's nuclear power plants there should be no room for complacency. Within a month after 9/11, New Delhi announced no-fly zone borders around nuclear power plants but these have not been strictly enforced. There is also not much information available on whether anti-aircraft defences protect these facilities or not, since aircrafts fly over BARC even today.

India's efforts towards countering proliferation of WMDs

India is cognizant of the challenges posed by proliferation of WMD and their delivery means to its national security and the international order. Based on these considerations, India has taken substantive steps to combat the illicit proliferation of weapons of mass destruction. India recognizes the significance of export controls not only for its own national security but also for the international order. India has thus committed to cooperate with the international community to promote and advance the goals of non-proliferation and international security. As a responsible nuclear power possessing advanced and sensitive nuclear technology and materials, India recognizes the critical importance of conscientious handling of its nuclear materials and technology right from its production stage to usage and its safe and secured disposition. Towards that end, India has joined the Convention on the Physical Protection of Nuclear Material (CPPNM) and the Convention on Nuclear Safety (CNS) both of which are directed towards the protection of nuclear facilities and safeguards. In November 2004, India submitted its first report on measures taken to implement the obligations set by UNSCR 1540. Following September, India played

an exemplary role by promulgating an ordinance to amend the "Unlawful Activities Prevention Act" of 1967, which enhanced punishment for any "unauthorized possession of any bomb, dynamite, or hazardous explosive substance capable of mass destruction or biological or chemical substance of warfare." Thereafter, India demonstrated consistent adherence to the UNSCR 1540 resolutions by further submitting two more reports to the Security Council in 2006.

As a responsible nuclear capable state, India refrains from any illicit nuclear activity involving aiding and abetting terrorists. Its intentions can be discerned from its Weapons of Mass Destruction and their Delivery Systems (Prohibition of Unlawful Activities) Act of 2005 (WMD Act) which criminalizes any transfer of WMD, missiles specially designed for their delivery, and WMD-usable materials, equipment and technologies; or to transfer fissile or radioactive material for use in terrorist acts (Sections 8 & 9). In 2010, the Indian Parliament passed the Foreign Trade Act which has broadened the domain of dual-use controls. Earlier in 2013, India's efforts to further tightening its export controls was made evident by announcing that India's national Special Chemicals, Organisms, Materials, Equipment and Technologies (SCOMET) list has been updated to be on par with the existing NSG and MTCR lists and are expected to be "more stringent than those practiced by the NSG and MTCR".

Conclusion

The danger of nuclear terrorism is of low-probability, yet of a high-consequence probability. Despite, the endeavour to reduce the risk of nuclear terrorism, the issue is still devoid of serious debate and awareness. Excessive emphasis on secrecy can impede an impartial assessment of the threat scenario causing serious drawback in reducing the risk. The need of the hour is a comprehensive legislation to provide clear directions for effective nuclear disaster management. Though, the Disaster Management Act (DMA) 2005 publicises certain guidelines, a 'more dedicated policy framework' is required to combat the threat. A more dedicated policy framework would essentially compose of comprehensive supporting infrastructure capable of delivering expertise and immediate response in coping with the challenge of nuclear terrorism.

India must consider the provisions for an Indian Department of Homeland Security analogous to that of the US in increasing and expanding critical intelligence to combat the threat. Efforts must be undertaken to periodically review and reassess the Design Basis Threat (DBT) to deal with threat scenarios post 9/11. The revision of DBT is of crucial importance especially since India is planning to expand its nuclear establishment. The credibility of the security infrastructure needs to be reassessed. The growing power and influence of the Taliban and Al Qaeda in Afghanistan and Pakistan is a strong reason to review the DBT. Since nuclear terrorism is an unpredictable reality, India must develop an attribution capability similar to the nuclear attribution programme developed by the US Department of Defence.[125] There is also the necessity to employ sabotage resistance safety systems. The IAEA has adopted an integrated approach to protection against nuclear terrorism.[126] This approach coordinates IAEA activities concerned with the physical protection of nuclear material and nuclear installations, nuclear material accountancy, detection of and response to trafficking in nuclear and other radioactive material, the security of radioactive sources, security in the transport of nuclear and other radioactive material, emergency response and emergency preparedness measures in member states and at the IAEA, and the promotion of adherence by states to relevant international instruments.[127] The IAEA also helps to identify threats and vulnerabilities related to the security of nuclear and other radioactive material.[128] The integrity of security forces like the CISF should be further reassessed. The Personnel Reliability Programme (PRP) should be reassessed periodically to meet the challenges of the insider problem in countering the threat of nuclear terrorism.

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[125] See Statement by Congressman Adam Schiff, Hearing on H.R. 2631, Nuclear Forensic and Attribution Act House Committee on Homeland Security Subcommittee on Emergency Threats, Cyber security, and Science and Technology, October 10, 2007, at http://homeland.house.gov/SiteDocuments/20071010175127-33681.pdf (Accessed June 1, 2008).

[126] See 'Engineering Safety Aspects of the Protection of Nuclear Power Plants against Sabotage', IAEA Nuclear Security Series No. 4, Technical Guidance, International Atomic Energy Agency, Vienna, 2007.

[127] Ibid.

[128] Ibid.

There is also the need to establish a Nuclear Information Management (NIM) programme to preserve a record of information that emerges at every stage of development of nuclear energy – fissile material mining, waste management, etc. Efforts should be made to use this information in a sustainable way. Preservation of vital information at every stage of nuclear mining is of vital importance to prevent any leakage of sensitive information. This necessitates periodic reassessment of research information storage systems for managing sensitive nuclear information.

The medical system of the country should be adequately equipped to deal with any emergency or incident of nuclear attack. It would be prudent on the part of the Indian government to include necessary courses to respond to such an emergency in the medical syllabus of the country. In addition, the fire brigade systems, the police training units and the trauma control centres needs to be adequately equipped to cope with a nuclear disaster.

Substantial international collaboration needs to be initiated and effected to evolve a coherent strategy to meet the challenge of nuclear terrorism. India and Pakistan have joined the Global Initiative to Combat Nuclear Terrorism (GICNT). They can also join the World Institute for Nuclear Security (WINS).The aim of the WINS is to promote the best security practices, eliminate weak links in the global security chain and ultimately, keep terrorists from getting the bomb.[129] The threat of nuclear terrorism can be substantially reduced in South Asia, if India and Pakistan mutually agree to reduce their fissile stockpile.[130]

In spite of the complexities involved, it remains an important fact that the threat of nuclear terrorism is no longer science fiction. It is a plausible phenomenon and the threat is credible in terms of the will and intention of the terrorists groups like Al Qaida to pursue the nuclear option. The only safeguard against this catastrophic possibility is concerted global efforts to counter and prevent it.

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[129] William J. Broad, 'New Security Organization Will Try to Prevent Nuclear Theft', *The New York Times*, September 29, 2008 at http://www.nytimes.com/2008/09/29/world/europe/29nuke.html?ref=world (Accessed September 30, 2008.

[130] See Z. Mian, A.H. Nayyar, R. Rajaraman and M.V. Ramana, 'Fissile Material in South Asia: The Implications of the US-India Nuclear Deal', *A Research Report of the International Panel on Fissile Materials*, (1), September 2006, pp. 9-15.

II Pakistan: Epicentre of Nuclear Terrorism*

Trends in South Asia, if left unchecked, will increase the odds that Al Qaida will successfully develop and use a nuclear device or biological weapon against the United States or its allies.

- World at Risk
The Report of the Commission on the
Prevention of WMD Proliferation and Terrorism
(December 2008)

Back in 1976, distressed by the dissemination of nuclear technologies and expertise to 'politically unstable countries', military intelligence historian Roberta Wohlstetter warned that a nuclear-armed Pakistan increased 'the probability of terrorist use of nuclear weapons considerably.'[1] Thirty-six years later in 2012, the Harvard Kennedy School in a study concluded that in Pakistan, the perils of nuclear theft is worsening, as the risks from a swiftly growing stockpile of nuclear weapons and increasingly capable adversaries offset nuclear security improvements.[2] Over the years, Pakistan's poor proliferation record and its strategic nuclear programme has portrayed it as a major concern for the security of the international community. These concerns stem

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* Parts of this paper are already published work of the author. See 'Pakistan's HEU-based Nuclear Weapons Programme and Nuclear Terrorism: A Reality Check', *Strategic Analyses*, Volume 3, Issue 6, November 2009, pp. 861 - 876.

1 Roberta Wohlstetter , 'Terror on a grand scale', *Survival*, 18(3)1976, pp. 98–104 stated in Charles P. Blair, 'Fatwas for fission: Assessing the terrorist threat to Pakistan's nuclear assets', *Bulletin of the Atomic Scientists*, 67(6)November/December 2011, pp. 19-33.

2 See Matthew Bunn, Martin B. Malin and Eben Harrell, 'Progress in Securing Nuclear Weapons and Materials: The Four-Year Effort and Beyond', *Harvard Kennedy School*, *Belfer Center for Science and International Affairs* Mass.: Project on Managing the Atom, Harvard University, Cambridge, March 2012), p. 5 at http://belfercenter.ksg.harvard.edu/files/Progress_In_The_Four_Year_Effort_web.pdf (Accessed March 20, 2012).

from several factors surrounding Pakistan's nuclear weapons programme, from Islamabad's ability to develop a coherent nuclear doctrine to the 'grey market' proliferation of nuclear materials and technologies by the Al Qaida Khan network.[3] The situation in Pakistan has further taken a turn for the worse with increasing political instability prevailing in the country giving rise to international concerns on the potential threat of Islamabad's nuclear weapons falling into the hands of terrorists. It is feared that Pakistan might lose control over its national 'crown jewels' to radical elements like Tehrik-i-Taliban (TTP) and Lashkar-e-Taiba (LeT) many of who keep close ties with Al Qaida.[4] John Brennan, assistant to the president for counterterrorism and homeland security, said at the time of Faizal Shahzad's[5] arrest that Tehrik-e-Taliban is 'closely allied with al Qaeda'.[6] The notorious David Headley[7], the Pakistani-American accused of the Mumbai attacks of 26/11 and who joined the LeT militant group hoping to fight in Kashmir, was also closely linked with Al Qaida. These concerns were earlier sounded

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3 Adrian Levy and Catherine Scott-Clark, *Deception: Pakistan, the United States, and the Secret Trade in Nuclear Weapons* Penguin Books, New Delhi, 2007, p.448; Christopher Clary, 'Dr Khan's Nuclear Walmart, *Disarmament Diplomacy*, (76), March/April,2004, at http://www.acronym.org.uk/dd/dd76/76cc.htm (Accessed January 20, 2012).

4 See 'Tehrik-i-Taliban Pakistan', *Dawn.com Pakistan*, January19, 2012 at http://dawn.com/2012/01/19/tehrik-i-taliban-pakistan/ (Accessed January 21, 2012); 'Lashkar-e-Taiba cadres sucked into al Qaeda orbit', *Dawn.com Pakistan*, November 7, 2010 at http://dawn.com/2010/11/07/lashkar-e-taiba-cadres-sucked-into-al-qaeda-orbit/ (Accessed November 21, 2010).

5 Faizal Shahzad is a Pakistani American who attempted the May 1, 2010, Times Square car bombing. On October 5, 2010, Shahzad was sentenced to life imprisonment without the possibility of parole after pleading guilty to a 10-count indictment in June, including charges of conspiracy to use a weapon of mass destruction and attempting an act of terrorism. Chad Bray, 'Times Square Plotter Gets Life Term', *The Wall Street Journal*, October 5, 2010, at http://online.wsj.com/article/SB10001424052748704469004575533902050370826.html?mod=djemalertNYnews (Accessed October 6, 2010).

6 Ashley Hayes, 'Is the U.S. safer today than before the 9/11 attacks?', *CNN US,* WORLD TRADE CENTRE, May 02, 2011at http://articles.cnn.com/2011-05-02/us/bin.laden.is.us.safer_1_al-qaeda-leader-yemeni-cleric-anwar-al-awlaki-attacks?_s=PM:US (Accessed May 7, 2011).

7 The US Federal District Court sentenced David C. Headley to 35 years in prison for committing the crime of helping to plan the deadly 2008 terrorist attacks in Mumbai. See Steven Yaccino, 'Planner of Mumbai Attacks Is Given a 35-Year Sentence', *The New York Times*, January 24, 2013 at http://www.nytimes.com/2013/01/25/us/david-c-headley-gets-35-years-for-mumbai-attack.html?_r=0 (Accessed January 24, 2013).

by the Chairman of the Senate Foreign Relations Committee, Senator John Kerry in October 2009, 'Pakistan is not only the headquarters of al Qaeda today, but it could easily become the epicentre of extremism in the world…….It is a fragile democracy that is fighting a determined insurgency. It has a full nuclear arsenal and a longstanding, sometimes violent rivalry with its neighbour, India."[8] These facts coupled with several other intelligence inputs from many quarters have raised widespread concerns about Pakistan being a very vulnerable site from where terrorists can gain access to nuclear materials or weapons. Former chief of the International Atomic Energy Agency (IAEA) described the acquisition of nuclear weapons by a terrorist group as the greatest threat facing the world, and pointed to the rise of the Taliban in Pakistan, 'We are worried because there is a war in a country with nuclear weapons."[9] The above described worrisome state of affairs often portrays Pakistan as the source of proliferation of its nuclear weapons, materials and technologies among terrorists groups like the Al Qaida and its affiliates in the international community. However, any presumption that Pakistan is not sufficiently competent to safeguard its strategic assets needs to be exhaustively and meticulously analysed.

Pakistan's Nuclear Weapons Programme

It is fairly well established that the chances of non-state actors executing out an act of nuclear terrorism is far-off. But, this remote possibility could take on an imaginable situation once the terrorists are triumphant in possessing weapons-grade fissile materials – highly enriched uranium (HEU) or plutonium (Pu). These uncontestable specifics when linked to the fact that Pakistan's nuclear weapons programme is HEU-based further magnify the threat of nuclear terrorism emanating from Islamabad.

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[8] Senator John Kerry, 'Afghanistan: Defining the Possibilities', *Address to the Council on Foreign Relations Committee*, October 26, 2009 at http://www.cfr.org/afghanistan/afghanistan-defining-possibilities/p20532 (Accessed October 29, 2009).

[9] Julian Borger, 'Mohamed ElBaradei warns of new nuclear age,' *Guardian*, May 14, 2009 at http://www.guardian.co.uk/world/2009/may/14/elbaradei-nuclear-weapons-states-un (Accessed December, 2011).

Nuclear Terrorism: A Reality Check

The existing state of affairs within the nuclear weapons technology area makes it understandable that the threat of nuclear terrorism is no more imaginary. Within South Asia, Pakistan's HEU-based nuclear weapons programme, poses considerable apprehensions. Pakistan's moderately outsized stockpiles of HEU engender worries that are no longer theoretical. The possible risks of terrorists gaining access to the country's HEU stockpile assumes more dangerous proportion with the current state of political instability in Pakistan headed by a weak government. However, these assumptions should be validated before drawing any conclusion on the potential threat of nuclear terrorism emanating from Pakistan.

First, are terrorist organisations aiming to procure nuclear weapons? Conventional literature indicates that while most terrorist outfits do not have a penchant for the nuclear weapons option, some groups do. These groups are basically the apocalyptic and politico-religious terrorist organisations like the Al Qaida. In December 1999, Osama bin Laden had exhorted upon the Muslims worldwide, 'Acquiring [nuclear and chemical] weapons for the defence of Muslims is a religious duty.'[10] Al Qaida pioneered by bin Laden had made constant efforts to procure fissile materials to construct a nuclear device. In August 2001, Osama bin Laden and Ayman al-Zawahiri received Pakistani nuclear scientists, Sultan Bashiruddin Mahmood and Abdul Majeed, and quizzed them on nuclear weapons and other weapons of mass destruction (WMD).[11] The Al Qaida was preceded by the Aum Shinrikyo who endeavoured to acquire nuclear weapons. Al Qaida's objective of acquiring nuclear materials remains unambiguous. In the spring of 2008, several websites belonging to radical extremists were citing reports about 'an impending nuclear attack on the US'.[12] Subsequently, in May 2008, a video was

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[10] Rahimullah Yusufzai, 'Wrath of God: Osama bin Laden Lashes out Against the West', *Time Asia*, . 153(1), January 11, 1999.

[11] Graham Allison, *Nuclear Terrorism: The Ultimate Preventable Catastrophe,* Henry Holt, (New York 2004, p. 20.

[12] William McCants, 'Going Nuclear', May 27, 2008, at http://www.jihadica.com/goingnuclear/ (Accessed August 2, 2008).

released calling for a fatal jihadi nuclear strike on America.[13] Though such statements do not explain much about the 'intention and capability of terrorists seeking nuclear weapons, this nuclear noise is nonetheless worrisome.' It is a dangerous pointer that some terrorists do have an aspiration to acquire nuclear weapons. From a motivational standpoint, the acquisition of a working nuclear weapon would represent the ultimate capability for apocalyptic and politico-religious terrorist groups.[14]

Second, do sophisticated terrorist groups have the potential of developing an operational crude nuclear device if they successfully procure the HEU? Recent trends in society specify that there has been a constant propagation of scientific and technical knowledge in the public sphere. Science remains no longer in the domain of secrets. Enormous literature is now available on how to fabricate a crude bomb from several sources (internet, declassified documents and PhD theses). A noteworthy study by the now-defunct congressional Office Technology Assessment (OTA) asserted, 'A small group of people, none of whom have ever had access to the classified literature, could possibly design and build a crude nuclear explosive device...Only modest machine-shop facilities that could be contracted for without arousing suspicion would be required.'[15] The then US Senator Joseph R. Biden way back in January 2004 instructed the heads of national laboratories to 'build, off the shelf, a nuclear device'. The scientists were able to 'actually construct this device'.[16]

It is also noteworthy that from the caves of Afghanistan, Al Qaida was able to architect and effectively carried out the 9/11 attacks. It is true that the 9/11 terrorist attacks consisted of no serious technical challenges of the kind a nuclear weapon poses. Yet, worse, the precision

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[13] William McCants, 'Insider Analysis of Nuke Tape', May 30, 2008, at http://www.jihadica.com/insider-analysis-of-nuke-tape/ (Accessed August 2, 2008).

[14] Charles D. Ferguson and William C. Potter, *The Four Faces of Nuclear Terrorism,* New York: Routledge, New York, 2005, p. 21.

[15] U.S. Congress, Office of Technology Assessment, Nuclear Proliferation and Safeguards (Washington, D.C.: OTA, 1977; at http://www.princeton.edu/~ota/disk3/1977/7705/7705.PDF (Accessed on August 27, 2008), p. 140.

[16] Joseph Biden's remarks at the Paul C. Warnke Conference on the Past, Present, and Future of Arms Control, Washington, DC, January 28, 2004 as cited in Graham Allison, *Nuclear Terrorism*, *op.cit*., p.95.

with which the Al Qaida was able to surmount the overwhelming challenges in implementing their operation warrants consideration. It can thus be supposed with a fair degree of certainty that the Al Qaida would be now further provoked to undertake a more demanding feat. Arguably, Al Qaida's labours to obtain a nuclear device were scuttled because of the oust of the Taliban rule by the North Atlantic Treaty Organisation (NATO) forces. However, reports indicate that Al Qaida is again reconstituting its centre of power to launch large complex operations from the Federally Assisted Tribal Area (FATA) and the North West Frontier Province (NWFP) regions of Pakistan.[17] Following the demise of bin Laden, rumours suggested that Al Qaida has been strategically contained. However, recent acts of terror committed by the Al Qaida and its franchise groups suggest that any such speculation can be 'deceptive'. Post 9/11, Al Qaida transformed into a more complicated, decentralised and elusive threat consisting of three elements: core Al Qaida; affiliates or franchise groups operating in places like Yemen and Somalia with loose ties to the core group; and homegrown terrorists inspired by violent extremism, often through the internet in the comfort of their own living rooms.[18] The 9/11 attack were carried out by 19 terrorists who were close associates of the Al Qaida. The mastermind of the 2010 Times Square car bomb plot was a naturalised American citizen trained by the Tehrik-e-Taliban (TTP), an affiliate of Al Qaida. The most spectacular and sophisticated attacks that the TTP is associated with—for example, the assassination of Benazir Bhutto, attacks on Pakistan's military headquarters, and the bombing of the Central Intelligence Agency (CIA) forwarding base Camp Chapman—all most likely, involved assistance from terrorist groups outside the immediate scope of the TTP.[19] The Al Qaeda in

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17 In his testimony before the Senate Select Committee on Intelligence, the then National Director of Intelligence John Negroponte on January 11, 2007 stated that the Al Qaeda had established a safe haven along Afghanistan-Pakistan border. See 'The Terrorist Threat to the US Homeland', National Intelligence Estimates, July 2007 at http://www.dni.gov/press_releases/20070717_release.pdf (Accessed August 27, 2008).

18 Amy Zegart, 'Al Qaeda is down, not out', *Los Angeles Times*, September 7, 2011 at http://articles.latimes.com/2011/sep/07/opinion/la-oe-zegart-alqaeda-20110907 (Accessed September 8, 2011).

19 Charles P. Blair, 'Fatwas for fission: Assessing the terrorist threat to Pakistan's nuclear assets', *Bulletin of the Atomic Scientists*, 67(6), November/December 2011, pp.19-33.

the Arabian Peninsula, an active affiliate of the Al Qaida claimed responsibilities for the attempted 2009 Christmas Day 'underwear bomber' aviation plot and the October 2010 plot to explode tampered printer cartridges aboard cargo planes. These splinter groups have risen dramatically in recent years making it quite impossible to believe that the Al Qaida has been strategically neutralised. However, the relevance of this debate is not based on Al Qaida's attacks or its attempted attacks on the US and its allies. What is germane in this context is whether the terrorists are capable of acquiring nuclear weapons or materials for their nefarious purposes.

Till date, there is no established record to suggest that terrorists have been successfully able to acquire an intact nuclear weapon or construct a crude nuclear device. What is the likelihood of terrorists acquiring nuclear capability? Matthew Bunn created a probability model in the *Annals of the American Academy of Political and Social Science* that estimates the probability of a nuclear terrorist attack over a 10-year period to be 29 per cent-identical to the average estimate from a poll of security experts commissioned by Senator Richard Lugar in 2005.[20] Several factors might play a dominant role in this probable outcome. Global Fissile Material Report 2011 provides updated estimates of the current global inventory of HEU to be about 1440 ± 125 tons,[21] most of it belongs to Russia and the US. The large uncertainty is due to a lack of accurate public information about Russian HEU production and consumption.[22] Pakistan and India are currently the only states producing HEU. At the end of 2011, India's HEU stockpile was estimated to be 2.0 ± 0.8 tons.[23] Pakistan continues to produce HEU for its nuclear-

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[20] See Matthew Bunn and Anthony Wier, 'Terrorist Nuclear Weapon Construction: How Difficult?', *The ANNALS of the American Academy of Political and Social Science*, 607, Confronting the Specter of Nuclear Terrorism, September 2006, pp. 133-149 and Senator Richard G. Lugar, 'The Lugar Survey On Proliferation Threats and Responses', (June 2005) at http://lugar.senate.gov/nunnlugar/pdf/NPSurvey.pdf (Accessed August 27, 2008).

[21] International Panel on Fissile Material, 'Global Fissile Material Report 2011', *Sixth Report of the International Panel on Fissile Material*, IPFM, Princeton, 2011, p.8.

[22] Ibid.

[23] This assumes an enrichment level of 30 per cent uranium-235 in the HEU, International Panel on Fissile Material, 'Global Fissile Material Report 2007', *op. cit.*, p.10. Also see Global Fissile Material Report 2010, ch. 9.

weapon programme. Accurate estimates are limited by the uncertainty about Pakistan's enrichment capacity, the operating history of its centrifuge plants at Kahuta, and the possible but unconfirmed existence of an additional plant at Gadwal.[24] It is estimated that, as of 2011, Pakistan could have a stockpile of about 2.75 ± 1 tons of weapon-grade (90 per cent -enriched) HEU.[25] It is believed that issues of global warming and unpredictable global oil pricing will accelerate the production of HEU for civilian uses. In addition, Russia will remain a source of fissile material stocks for other states and hence, continue to cause great anxiety for many years to come.[26] Further, it can be argued that although the overall security of global stockpile of HEU is improving[27] yet concerns remain over the HEU stockpiles of Russia and Pakistan. At the same time, terrorists may attempt to acquire fissile materials not from where it is easily available but from the sites where it is available in large stocks. Hence, the inventories of other nuclear weapon states remain as much vulnerable to nuclear theft and diversion, and pose a serious threat. The growing number of terrorist groups sharing the same ideology as that of the Al Qaida and their increasing sophistication might also alter the security calculus and reduce the odds against the terrorists' acquisition of fissile materials. Unless adequate steps are taken to curb these factors they might bolster the capability of the terrorists and bring them closer towards their goal.

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24 See Global Fissile Material Report 2010 ch. 10.

25 International Panel on Fissile Material, 'Global Fissile Material Report 2011', *op. cit.*, p.11.

26 Micah Zenko, 'Nuclear Site Is Breached', *The Washington Post,* December 20, 2007 at http://www.washingtonpost.com/wp-dyn/content/article/2007/12/19/AR2007121901857.htm/(Accessed August 27, 2008).

27 Since President Obama launched the four-year nuclear security effort, the United States has helped remove almost 1,000 kilograms of weapons-usable highly enriched uranium (HEU) from research reactor facilities, eliminated HEU entirely from six countries, and helped 14 HEU-fueled reactors move away from the use of weapons-usable fuel. More countries have ratified key nuclear security treaties; international recommendations have been strengthened; and efforts to strengthen nuclear security culture, provide adequate training, and exchange best practices in nuclear security have all been expanded. These efforts have reduced the threat of nuclear terrorism. See Matthew Bunn, Eben Harrell and Martin B. Malin, 'Progress on Securing Nuclear Weapons and Materials: The Four-Year Effort and Beyond', (Cambridge, Mass(?): Report for Project on Managing the Atom, Belfer Centreer for Science and International Affairs, Harvard Kennedy School, Cambridge,,March 2012.

Third, can a terrorist organisation like the Al Qaida manage to procure the necessary nuclear material for building a nuclear device? Fissile materials are housed in hundreds of buildings in many countries. Over 120 research and training reactors around the world still use HEU either as fuel or as targets for producing medical isotopes.[28] Security in several of these facilities, some are even on university campuses,---- significantly differs from one another. Though most of these reactors have modest amounts of HEU on-site, there are some facilities that houses substantial quantities of weapons-grade HEU sufficient for building crude 'gun-type' nuclear device. The reactor types causing most concern are critical assemblies and pulsed reactors, which often have hundreds of kilograms or even tons of high-grade HEU on-site. In the US, after years of failed security tests for critical assemblies at a site known as Technical Area 18 (TA-18) at Los Alamos, hundreds of kilograms of HEU in four critical assemblies were shipped to the highly secure Device Assembly Facility (DAF) at the Nevada National Security Site (formerly the Nevada Test Site). A critical assembly from Livermore was moved to the DAF as well. In February 2010, a group of peace activists climbed over the perimetre fence at Kleine-Borgel airbase in Belgium, where US nuclear weapons are reportedly stored.[29] The fence was a simple chain link fence with no intrusion detectors, and the group was not detected.[30] They were finally stopped by a single guard, whose weapon appeared to be unloaded, some 90 minutes after they entered the base.[31] Though, the area the activists penetrated was not the nuclear weapons storage area, this was a major security breach, revealing substantial weaknesses in the site's ability to detect, assess, and respond to adversary intrusions in a timely way.[32]

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[28] Ibid, pp.10-11.

[29] Matthew Bunn, 'Securing the Bomb 2010', *Belfer Center for Science and International Affairs*, September 2007, p.4.

[30] Ibid.

[31] See Jeffrey Lewis, 'Activists Breach Security at Kleine Brogel', *ArmsControlWonk.com*, February 4, 2010 at http://www.armscontrolwonk.com/2614/activists-breach-security-at-kleine-brogel (Accessed February 5, 2010) and Hans Kristensen, 'U.S. Nuclear Weapons Site in Europe Breached', *FAS Strategic Security Blog, Federation of American Scientists*, February 4, 2010, http://www.fas.org/blog/ssp/2010/02/kleinebrogel.php (Accessed February 5, 2010).

[32] Matthew Bunn, 'Securing the Bomb 2010', *op. cit.*, p.4.

Remarkably, security at the site was still weak despite a series of warnings of security problems and threats, including: (a) a November 2009 penetration of the site by the same peace group (which only reached the airstrip, not the area with the hardened bunkers);[33] (b) a 2008 report from an Air Force blue-ribbon panel that warned that there were significant security problems at European bases for US nuclear weapons, and that 'most sites require significant additional resources to meet [Department of Defence (DoD)] security requirements';[34] and (c) the 2001 arrest of an Al Qaida operative for planning to bomb the same base (and who testified that an insider at the base had sold photos of the facility to Al Qaida).[35]

Presently, Russia houses two-thirds of the critical assemblies and pulse reactors in the world, which poses acute concern. So far, not much has been done by Russia to convert this HEU into LEU fuel. Outside Russia, in December 2010, Belarus agreed to eliminate all the HEU on its soil. However, following election irregularities, the US imposed sanctions leading Belarus to freeze all cooperation on HEU removals. Ukraine has been more cooperative and announced that it would eliminate all the HEU on its soil, including some 75 kilograms of weapon-grade HEU powder at a research centre in Kharkiv.[36]

The Pelindaba incident further revalidates the low security standards of the nuclear facility sites. In November 2007, four armed men broke into Pelindaba nuclear facility in Pretoria, a site where an estimated 25 bombs' worth of weapons grade uranium is stored.[37] These four

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33 Ibid.

34 Major General Polly A. Meyer, chair, 'Air Force Blue Ribbon Review of Nuclear Weapons Policies and Procedures', *Headquarters US Air Force* (Washington, D.C.: U.S. Air Force(?), February 8, 2008), p.52 also available at http://www.fas.org/nuke/guide/usa/doctrine/usaf/BRR-2008.pdf (Accessed March 5, 2012).

35 'Al-Qaeda Suspect Tells of Bomb Plot', *BBC News*, May 27, 2003 http://news.bbc.co.uk/2/hi/europe/2941702.stm (Accessed February 5, 2010).

36 Matthew Bunn, 'Progress on Securing Nuclear Weapons and Materials: The Four-Year Effort and Beyond', op. cit., p.11.

37 The Pelindaba nuclear facility is one of South Africa's most heavily guarded 'national key points' -defined by the government as 'any place or area that is so important that its loss, damage, disruption or immobilisation may prejudice the Republic'. See Micah Zenko, 'A Nuclear Site is Breached', *Washington Post*, December 20, 2007, p. A29.

'technically sophisticated criminals' deactivated several layers of security, including a 10,000-volt electrical fence, suggesting insider knowledge of the system.[38] It must be noted that if the armed perpetrators had accomplished in penetrating the site's highly enriched uranium vault, they could have taken away fissile materials for the world's first terrorist nuclear bomb. This incident is an indicator to the significance of upgrades in the physical protection of nuclear facilities. However, following the Pelindaba incident,President Barack Obama's four-year effort to secure all nuclear weapons and materials began. South Africa has completed substantial security upgrades at Pelindaba, where its HEU is located. South Africa has also converted its research reactor at Pelindaba to use LEU fuel, and is in the process of converting the targets it uses for medical isotope production from HEU to LEU.[39] It has shipped some irradiated US-origin HEU fuel back to the US.[40] However, South Africa is yet to commit to eliminate the hundreds of kilograms of weapon-grade HEU left over from its weapon programme, but talks on that subject are ongoing.[41]

There are other hazards that can further facilitate the objective of the terrorists to acquire the necessary fissile materials – risks during transportation of nuclear materials particularly HEU, which has several civilian applications. Nuclear warheads and weapons-usable materials remain highly vulnerable while they are being transported. When these items are being shipped, it is impossible to provide multiple layers of detection and delay that can be put in place at a fixed site.[42] Though, there are measures such as 'armed guards accompanying the transports, vehicles with special protection against hijack and sabotage, secrecy concerning the schedule and route of the transports, and continuous or frequent tracking of the transport en route', these can be sabotaged. The issue of providing adequate security to nuclear material shipments

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38 Micah Zenko, 'A Nuclear Site is Breached', *Washington Post*, December 20, 2007, p. A29.

39 Matthew Bunn, 'Progress on Securing Nuclear Weapons and Materials: The Four-Year Effort and Beyond', *op. cit.,* p.11.

40 Ibid.

41 Ibid.

42 Matthew Bunn, 'Securing the Bomb 2007', Belfer Center for Science and International Affairs, September 2007, p.12.

has been a subject of controversy. The fact is that it is difficult to provide the same level of security for items in transport as they can have at large fixed sites.[43] The point of acute vulnerability during transport may be more likely to occur during a crisis when consolidation of armaments may be viewed as a method of control.[44] Recent reports have indicated that the Pakistan army had taken to transporting nuclear warheads around the country in unmarked civilian vehicles through heavily trafficked roads. The rationale being doing so as explained by General Khalid Kidwai is to redouble the Strategic Plans Division's (SPD) efforts to keep Pakistan's nuclear arsenal concealed in an attempt to keep the US and Indian intelligence agencies guessing about their locations. According to several Pakistani reports, General Kidwai ordered an increase in the tempo of the dispersal of nuclear-weapons components and other sensitive materials.[45] One method the SPD uses to ensure the safety of its nuclear weapons is to move them among the 15 or more facilities that handle them.[46] Nuclear-weapons components are sometimes moved by helicopter and sometimes moved by road. Instead of moving nuclear material in armoured, well-defended convoys, the SPD prefers to move material by subterfuge, in civilian-style vehicles without noticeable defences, in the regular flow of traffic.[47] And according to a senior US intelligence official, the Pakistanis have begun using this low-security method to transfer not merely the 'de-mated' component nuclear parts but 'mated' nuclear weapons also.[48] It would not be impertinent to state that a country facing acute threat from terrorists willing to unleash catastrophic terror and headquarters to Al Qaida, LeT, and the Haqqani network is lowering its security to appalling standards. Pakistan is increasing the vulnerability of both mated

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43 See Graham Allison, *Nuclear Terrorism: The Ultimate Preventable Catastrophe,* Henry Holt, New York, 2004 and Matthew Bunn, 'Securing the Bomb 2007', Belfer Centre for Science and International Affairs, September 2007.

44 Gary Ackerman and Jeremy Tamsett (eds.), *Jihadists and Weapons of Mass Destruction: A Growing Threat,* CRC Press, Boca Raton 2009, pp. 291-292.

45 Jeffrey Goldberg and Marc Ambinder, 'The Ally from Hell,' *Atlantic Magazine*, December 2011 at http://www.theatlantic.com/magazine/archive/2011/12/the-ally-from-hell/8730/ (Accessed December 29, 2011).

46 Ibid.

47 Ibid.

48 Ibid.

and de-mated nuclear bombs to nuclear theft and increasing the chances of terrorist acquisition of nuclear weapons.

The risks of transportation might be further exacerbated during crisis times wherein Pakistan might feel its security is threatened and would consider moving its nuclear warheads for purposes of mating them with the delivery vehicles. In such a scenario, there maybe a 'window of opportunity' for a terrorist group to steal a nuclear weapon as the Pakistani military assembles and transports the warheads and delivery vehicles.[49]

Theft of HEU

According to Ferguson and Potter, while the acquisition of intact nuclear weapons would be 'the most difficult challenge for any terrorist organisation', there are several other ways through which a terrorist group can obtain weapons usable materials. One scenario would be the collapse or failure of a state with a nuclear arsenal. It would raise the potential for nuclear weapons and materials to be diverted or stolen and is a major fear with respect to Pakistan given its recent instability.[50] It is unlikely for terrorists seeking weapon-usable nuclear material to undertake the option of enrichment of uranium for fabricating a nuclear device since it will be technically challenging. Theft of HEU by probable nuclear terrorists is no longer a hypothetical possibility. This possibility is not only due to less demanding technical requirement but also due to the amounts of HEU stockpiled around the world. The risk of nuclear theft is determined by the quantity and quality of nuclear material available to be stolen- in particular, how difficult it would be to make a bomb from it, or to get a detonation from a weapon that is stolen,

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[49] See Marko Beljac, 'Pakistan's nukes - how secure?', *Online Opinion*, October 19, 2009 at http://www.onlineopinion.com.au/view.asp?article=9576 (Accessed March 19, 2012); Seymour M. Hersh, 'Defending the Arsenal: In an unstable Pakistan, can nuclear warheads be kept safe?' *The New Yorker*, November 16, 2009 at http://www.newyorker.com/reporting/2009/11/16/091116fa_fact_hersh (Accessed March 19, 2012); Zafar Ali, 'Pakistan's Nuclear Assets and Threats of Terrorism: How Grave is the Danger?' *The Henry L. Stimson Centre*, July 2007.

[50] Michael E. Clarke, 'Pakistan and the "four faces" of nuclear terrorism', in Ashutosh Misra and Michael C Clarke (eds.), *Pakistan's Stability paradox: Domestic, regional and international dimensions*, Routledge, New York ,2012, p. 193.

the effectiveness of the security measures in place, and the plausible adversary capabilities those security measures must protect against.[51] The Harvard Kennedy School has identified three highest risk zones from where there is a probability of diversion of HEU stocks. These zones include Pakistan, Russia and HEU fueled research reactors. It is noteworthy that of the cited high risk zones, Pakistan tops the list with progress on its nuclear security unknown and worsening risk trends.[52] It is feared that sympathetic insiders might aid and assist a nuclear theft by terrorists. It is also apprehended that the stringent defences that Pakistan claims to be in place within its nuclear establishment might be circumvented by a sophisticated outside attack possibly with insider collusion. The blitz attack launched on Pakistan Naval Station Mehran in Karachi in May 2011 was like a sophisticated war operation with the militants piercing the naval installation's defences to race through what should have been a well-defended base and wreaking havoc on the garrison.[53] It was a well-planned mini-invasion by highly trained killers who appeared to be well-acquainted with the layout of the naval aviation base.[54] They knew the location of their targets, both men and material, and displayed utter contempt for the naval personnel through their astonishing speed and firepower.[55] The incident raised several questions about the state of preparedness of the Pakistani defence forces particularly that of the navy. Attacks of this kind raise significant threats to the security of Pakistani nuclear weapons and the sites housing nuclear materials.

Apart from Pakistan, theft of HEU is a worrisome possibility in other high risk zones. In February 2006, Russian citizen Oleg Khinsagov was

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51 Matthew Bunn and Eben Harrell, *Consolidation: Thwarting Nuclear Theft, Project on Managing the Atom*, Harvard University, Cambridge, MA 2012) at http://belfercenter.ksg.harvard.edu/publication/21818/consolidation.html (Accessed March 27, 2012), pp. 4-9.

52 Matthew Bunn, 'Progress on Securing Nuclear Weapons and Materials: The Four-Year Effort and Beyond', *op. cit.,* p. 5.

53 'PNS Mehran attack', *Dawn.com*,, May 24, 2011 at http://dawn.com/2011/05/24/pns-mehran-attack/ (Accessed May 25, 2011).

54 Ibid.

55 Ibid.

arrested in Georgia (along with three Georgian accomplices) with some 100 grams of HEU enriched to 89 per cent U-235.[56] According to the IAEA, there have been a 'disturbingly high' number of reports of missing or illegally trafficked nuclear material. According to agency figures, there were 243 incidents between June 2007 and June of this year.[57] However, the amounts reported missing has been minimal. Insider sabotage can also be a potential source for the terrorists to acquire nuclear materials for their objective.

Fourth, does Al Qaida have the indispensable delivery vehicles to transport a crude nuclear device to the target location? Regrettably, the answer to this question is in the affirmative. A rudimentary nuclear device unlike a sophisticated nuclear bomb does not need sophisticated launch pads (missiles, mortars). Crude nuclear bombs can be easily transported in an automobile or van for subsequent detonation in the target location. Other delivery means can include trucks, hot-air balloons, and ships. Moreover, with the upsurge of suicide bombers who seek martyrdom, a crude nuclear weapon can be easily transported for detonation in a densely populated area.

Porous borders can further make possible the illicit trafficking of nuclear and radioactive materials by terrorists. South Asia has thousands of miles of porous borders manned by poor security that can increase the risks of terrorists smuggling nuclear materials across borders.[58]

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[56] Elena Sokova, William C. Potter, and Cristina Chuen, 'Recent Weapons Grade Uranium Smuggling Case: Nuclear Materials are Still on the Loose', Center for Nonproliferation Studies, Monterey Institute of International Studies, January 26, 2007; at http://cns.miis.edu/pubs/week/070126.htm (Accessed July 9, 2007). Also see Michael Bronner, '100 Grams (And Counting): Notes From the Nuclear Underworld', Project on Managing the Atom, Harvard University, Cambridge, Mass, June 2008, at http://belfercenter.ksg.harvard.edu/publication/18361/100_grams_and_counting.html (Accessed October 2, 2008).

[57] 'Keeping tabs on nuclear material', *International Herald Tribune*, November 2, 2008.

[58] Nearly 100 militants belonging to the Lashker-e-Taiba, Jaish-e-Mohammed and Harkat-ul-Mujahideen have managed to slip into Jammu and Kashmir in recent weeks, after which the authorities beefed up security around key installations in the state. See 'Nearly 100 Terrorists Sneak Into J&K', *India TV*, April 22, 2009 at http://www.indiatvnews.com/election09/newsdetails.php?id=326&pg=index (Accessed April 24, 2009).

Despite the reality check on nuclear terrorism posing a very dismal picture, there is some sanguine news as well. There is no substantial evidence to argue that terrorists have acquired the required proficiency to construct a bomb. There is also no credible evidence to corroborate the assertion that terrorists can effectively construct a crude nuclear device with HEU. Building a crude nuclear device can be a challenging task involving several complexities as encountered by the Al Qaida and Aum Shinrikyo groups. There is also an emerging debate within the radical Islamic groups about the moral legitimacy of mass killing of innocent people.[59] Nuclear security has also been improving though there is still much to be done. However, this positive aspect also comes with the caveat 'as of now'. It is difficult to exactly quantify the chances of nuclear terrorism. However, the costs of a nuclear terror attack are considerably high enough to warrant comprehensive security of the nuclear weapons and materials.

Worsening risk trends in Pakistan

Pakistan is slowly making efforts to improve its nuclear security apparatus. It has taken up major upgrades in the security of its nuclear programme. Much of these upgrades began prior to the four years resolution undertaken by President Obama in April 2009 in Prague. Following this the US has reportedly broadened its cooperation with Pakistan since 2009.[60] Significantly, though Pakistan shares the US concern of the growing extremist threats prevailing within the country, Islamabad's priority is to protect its nuclear arsenal against a hypothetical Indian or American strike. This is a worrisome trend. Though, Pakistan is making an attempt to improve the security situation yet the grave danger remains that it could unintentionally become a source of a nuclear terror attack on India and the rest of the world. Indeed, in a 2007 *Foreign Policy* Magazine poll 74 per cent of 117 non-governmental terrorism experts

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[59] Lawrence Wright, 'The Rebellion Within', *The New Yorker*, June 2, 2008 at http://www.newyorker.com/reporting/2008/06/02/080602fa_fact_wright (Accessed June 3, 2008).

[60] See David Sanger and William Broad, 'U.S. Secretly Aids Pakistan in Guarding Nuclear Arms', *New York Times*, November 17, 2007; Joby Warrick, 'U.S. Has Concerns Over Security of Pakistan's Nuclear Weapons', *The Washington Post*, November 11, 2007; Jane Perlez, David E. Sanger, and Eric Schmitt, 'Nuclear Fuel Memos Expose Wary Dance With Pakistan', *New York Times*, November 30, 2010.

opined that Pakistan was likely to transfer nuclear technology to terrorists in the next three to five years.[61] Another thought that provokes unease is that Pakistan has emerged as the safe haven for Al Qaida because of continual attacks on the tribal militants by the NATO forces within Afghanistan. The Al Qaida by upholding the cause of the Afghan insurgents has acquired favours from the tribal militants who provide the Al Qaida terrorists a safe haven in FATA and NWFP. The radical elements within Pakistan are further encouraged when extremist leaders like Hafiz Saeed are freely allowed to address public rallies, stoking the fire of radicalism further. Recent reports note that Pakistan's chief Hakeemullah Mehsud of the Al Qaida's franchise group TTP has warned that if the NATO supply routes were reopened, the militants would 'show their anger' through terrorist activities across Pakistan, including targeting high-profile personalities.[62] At a joint press conference held between the US and Pakistan in April 2012, the CIA shared intelligence suggesting that the Al Qaeda planned to carry out major attacks inside Pakistan.[63] The information was based on documents seized by the US Navy Sea, Air, Land Teams (SEALs) during the raid on Osama bin Laden's compound in Abbottabad in 2011.[64] The political volatility existing in the nuclear capable country since the late 2007 makes it a prospective place for terrorists to obtain nuclear weapons and materials. The *Asia Pacific Security Survey 2008 Report* ranked instability in Pakistan and Burma as the most serious specific concerns.[65] The level of concern over instability in Pakistan was the only issue among others that that received an overall 'serious' rating (level 4).[66]

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61 Ibid.

62 'Taliban to strike if Pakistan reopens Nato routes', *The Times of India*, April 20, 2012 at http://articles.timesofindia.indiatimes.com/2012-04-20/pakistan/31373563_1_nato-supply-routes-media-report-afghan-taliban (Accessed April 20, 2012).

63 Baqir Sajjad Syed, 'CIA alerts Pakistan to Al Qaeda plan', *Dawn.com*, April 27, 2012 at htttp://dawn.com/2012/04/27/cia-alerts-pakistan-to-al-qaeda-plan/ (Accessed April 27, 2012).

64 Ibid.

65 Richard W. Baker and Galen W. Fox, 'Asia Pacific Security Survey Report', East-West Centre,Honolulu 2008), pp. 5-7 at http://www.eastwestcenter.org/sites/default/files/private/apss2008_1.pdf (Accessed April 27, 2012).

66 Ibid.

This ranking further reinforces the seriousness of the concern prevailing about Pakistan.

Pakistan's expanding nuclear arsenal is a further cause of concern. Amidst growing political instability and extremist threats, Pakistan is steadily expanding its nuclear weapons stockpile. According to a secret US cable published by Wikileaks, the US officials suggested in 2008 that Pakistan was 'producing nuclear weapons at a faster rate than any other country in the world'.[67] It is estimated that, as of 2011, Pakistan could have a stockpile of about 2.75 ± 1 tons of weapon-grade (90 per cent-enriched) HEU.[68] An additional 0.1 tons may have been consumed in Pakistan's six nuclear weapon tests in 1998.[69] As of 2011, the US Government estimates Pakistan's stockpile to range from 90 to over 110 weapons.[70] It is estimated that, as of 2011, Pakistan could have a stockpile of about 2,750 kg of weapons-grade (90 per cent-enriched) HEU and may be producing about 150 kg of HEU per year.[71] Assuming that about 20 kg of HEU is required per warhead, Pakistan's current stockpile would be sufficient for about 140 weapons.[72] These are frightening developments. Should Pakistan slip into increasing political instability and concurrently its nuclear arsenal grows, the risk of terrorists seizing nuclear materials becomes greater. Immediately, after the completion of the US-India civil nuclear deal, China agreed

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67 Briefing by Peter Lavoy, US National Intelligence Officer for South Asia, to NATO Permanent Representatives, November 25, 2008, summarised in classified US cable EO 12958, ID USNATO4535, December 5,2008 at http://www.cablegatesearch.net/ (Accessed March 4, 2012). cable.php?id=08USNATO453&version=1315488573.

68 Global Fissile Material Report 2011: Nuclear Weapon and Fissile Material Stockpiles and Production Sixth annual report of the International Panel on Fissile Materials 2011 at http://fissilematerials.org/library/gfmr11.pdf p.11, (Accessed March 4, 2012).

69 Ibid.

70 David E. Sanger and Eric Schmitt, 'Pakistani Nuclear Arms Pose Challenge to U.S. Policy', *New York Times,* January 31, 2011.

71 Global Fissile Material Report 2011: Nuclear Weapon and Fissile Material Stockpiles and Production, International Panel on Fissile Materials, January 2012.

72 Ray Acheson (ed.), 'Assuring Destruction Forever: Nuclear Weapon Modernization Around the World', *Reaching Critical Will*,(2012 at http://reachingcriticalwill.org/images/documents/Publications/modernization/assuring-destruction-forever.pdf (Accessed April 24, 2012).

to build two nuclear power plants in Pakistan.[73] Noteworthy, neither of these reactors nor the separation plant is monitored by the IAEA. Hence, there remains the risk of possible diversion of plutonium from the new production reactors in Khushab and the newly reconstituted reprocessing plant. In the backdrop of the fragile situation prevailing in Pakistan, possible diversion of U-235 from Khan Research Laboratory (KRL) cannot be ruled out. The Pakistani military has taken great care about the safety of their nuclear weapons based upon carefully formulated personal reliability programmes and electronic safety mechanisms. However, sparse information and lack of transparency mark these claims as far from reassuring on the safety and security of Pakistan's nuclear weapons and materials. Moreover, Pakistan might possibly have only a 'guards, guns and gates' method of security system, which in all probability lacks state-of-art physical protection, material control, and accounting technologies.[74] Pakistan's planned expansion of its nuclear arsenal at a time when the country is rife with extremist forces seeking nuclear materials and a not-so efficient security personnel system 'all point to the possibility that future nuclear material diversion attempts might be successful.'[75]

The nexus between Pakistan's Inter Services Intelligence (ISI) and the terrorists operating in Pakistan's tribal areas is extensively worrisome. On July 12, 2008, a top CIA official, Stephen R. Kappes travelled to Pakistan and confronted senior officials in Islamabad with credible

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[73] 'China to help build 2 Pakistan nuclear plants', *International Herald Tribune*, October 18, 2008.

[74] See Shaun Gregory, 'The Security of Nuclear Weapons in Pakistan', *Pakistan Security Research Unit,* (PSRU) (22), November 18 2007, at http://spaces.brad.ac.uk:8080/download/att achments/748/Brief_22finalised.pdf (Accessed September 24, 2008); Nathan Busch, 'No End in Sight: The Continuing Menace of Nuclear Proliferation', University Press of Kentucky, Lexington, KY 2004; Mahmud Ali Durrani, 'Pakistan's Strategic Thinking and the Role of Nuclear Weapons', Cooperative Monitoring Center, Occasional Paper 37, SAND 2004-3375p(Albuquerque, New Mexico, July 2004; at httpp://www.cmc.sandia.gov/cmc-papers/sand2004-3375p.pdf (Accessed July 2, 2008); and Kenneth N. Luongo and Brig. Gen. (Ret.) Naeem Salik, 'Building Confidence in Pakistan's Nuclear Security', Arms Control Today, December 2007, at http://www.armscontrol.org/ act/2007_12/Luongo.asp (Accessed July 2, 2008).

[75] Chaim Braun, 'Security Issues Related to Pakistan's Future Nuclear Power Program', in Henry D Sokolski (ed.), *Pakistan Nuclear Future: Worries beyond war*, Strategic Studies Institute, Carlisle PA: US Army War College, 2008), pp. 283-286.

information about ties between the ISI and the militant network led by Jalaluddin Haqqani, which according to the US also maintains close ties with senior figures of the Al Qaida in Pakistan.[76]

The volatile situation in Pakistan has become further unstable with the existence of terrorist groups like Jaish-e-Mohammed, LeT and Harkat-ul-Jehad-al-Islami who are being influenced by the Al Qaida led pan-global jihadi ideology and are intensely active in the Indian sub-continent. The degree of the crisis merits solemn deliberation since the Al Qaida has articulated its aspiration to attain nuclear/radiological materials and weapons, and have touched base with diverse individuals and militant groups to obtain these sensitive technology and materials for purposes of weaponisation. Investigations into the recent Mumbai blasts of November 26, 2008 have provided credible information of the involvement of the LeT operating from Pakistani soil.[77] It is alleged that the LeT had the backing of the ISI, which shared intelligence with the Lashkar and provided it protection in the Mumbai terror attacks.[78] The horrific Mumbai attacks could also be viewed as a strategic ploy by the Tehrik-e-Taliban Pakistan.[79] An Indian retort would assist the cause of the Taliban as it could compel the Pakistani Army to reorganize military action from the tribal areas and the Swat valley to its eastern borders. Post Mumbai blasts, a series of cross border accusations between India and Pakistan led to the redeployment of about a thousand Pakistani soldiers from the western to the eastern border of Islamabad. Lack of attention to the militant tribal areas would serve

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[76] The meetings took place days after a suicide bomber attacked the Indian Embassy in Kabul, killing dozens. There were strong reports of the involvement of the ISI in these blasts. Mark Mazzetti and Eric Schmitt, 'Nexus of Evil: CIA's Secret Pak Tour Unearths ISI-Militant Links', *Hindustan Times*, July 31, 2008, p.17.

[77] Carlos Hamann, 'US intelligence chief implicates Lashkar-e-Taiba in Mumbai attacks', *Hindustan Times*, December 03, 2008, 'Mumbai attacks: UK tells Pak its time for action, not words', *The Hindu*, December 14, 2008.

[78] 'ISI provided protection to LeT in Mumbai attacks: NYT', *Indian Express*, December 8, 2008.

[79] See Barnett R. Rubin and Ahmed Rashid, 'From Great Game to Grand Bargain', *Foreign Affairs*, 87(6) November/December, 2008.

the purposes of the LeT who have declared their goal to dissolve India.[80]

The probability of atomic terrorism in South Asia is increasingly gaining grounds. The assassination of Pakistan's former Prime Minister, Benazir Bhutto has reinforced apprehensions over the probability of Pakistan's nuclear weapons and materials falling into the hands of the Al Qaida. Pakistan's former President, Musharraf was also subjected to seven known assassination attempts in some of which, Pakistani military and intelligence officials were deeply involved.[81] When such is the state of Pakistan's security system where they cannot accord adequate and effective security to their heads of the state and where political instability is deepening, it is not easy to ignore the probability of penetration by Al Qaida militants to obtain fissile materials, if not weapons, from Pakistan's inventory.

Matters within the Strategic Plans Division (SPD) are also troublesome. Reports indicate that the SPD is faces political pressure in the appointment of its staff. This will definitely lead to a compromise on the standards of competence of the people recruited and entrusted with the sensitive task of the protection of Pakistan's nuclear assets. It might also result in politicising the strategic organisations, which will prove to be very harmful.

Pakistan's Code System Technology

Following the revelation of the global black-market led by A.Q. Khan in 2004, Pakistan undertook major reforms of its nuclear command, control, and security systems.[82] To preclude any possibility of inadvertent or unauthorised use of nuclear weapons, Pakistan has developed physical safety mechanisms and firewalls both in the weapons systems

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[80] Ashley J Tellis, 'Terrorists Attacking Mumbai Have Global Agenda', *Yale Global Online*, December 8, 2008 at http://yaleglobal.yale.edu/display.article?id=11695 (Accessed December 8, 2008).

[81] 'Pakistani Links Military to Failed Plot to Kill him', *The New York Times*, May 28, 2004.

[82] International Institute for Strategic Studies, *Nuclear Black Markets: Pakistan, A.Q. Khan and the Rise of Proliferation Networks: A Net Assessment,* IISS, London, 2007, pp. 112-117.

themselves and in the chain of command.[83] No single individual can operate a weapon system, nor can one individual issue the command for nuclear weapons use.[84] It is believed that the SPD in entrusted with the physical management of Pakistan's nuclear arsenal. The SPD is reported to have a special unit consisting of roughly 12,000 personnel dedicated for the security of nuclear assets. In addition Pakistani officials have asserted that its nuclear arsenal is safeguarded by an authenticated code technology outfitted with systems that will thwart any unauthorised access to the nuclear weapons. The US has a code system technology – 'Permissive Action Links' which are integral to the design of the weapon, extremely difficult to bypass, and have 'limited try' features that will permanently disable the weapon if someone inserts the wrong code too many times.[85] However, there is a lot of uncertainty whether Pakistan has also developed a code system technology analogous to that of the US system. In 2002, the widely cited Landau report stated that Pakistan did not have Permissive Action Links (PAL)-type technology.[86] In March 2005, General Khalid Kidwai indicated that Pakistan had developed 'enabling and authenticating codes'[87] for the physical protection of its nuclear assets. This signifies that Pakistan might have an unsophisticated PAL-type technology for its nuclear arsenal that may be easy to circumvent. Alternatively, it may relate to a system for only locking delivery systems.[88] It is believed that since Pakistan's nuclear weapons

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83 Khalid Banuri and Adil Sultan, 'Managing and securing the bomb', *Daily Times*, May 30, 2008 at http://www.dailytimes.com.pk/default.asp?page=2008%5C05%5C30%5Cstory_30-5-2008_pg3_6 (Accessed July 2, 2008).

84 Ibid.

85 David Albright, 'Securing Pakistan's Nuclear Infrastructure', in Lee Feinstein et al., A New Equation: U.S. Policy toward India and Pakistan after September 11 Carnegie Endowment for International Peace, Washington, D.C 2002; at http://www.carnegieendowment.org/fi les/wp27.pdf (Accessed July 2, 2008).

86 See Cotta-Ramusino and Maurizio Martelline, *Nuclear Safety, Nuclear Stability and Nuclear Strategy in Pakistan*, Landau Network – Centro Volta, January 2002 at http://lxmi.mi.infn.it/~landnet/Doc/pakistan.pdf (Accessed December 2, 2008).

87 This can be questionable since there is no official report substantiating the General's claims. See Shaun Gregory, 'The Security of Nuclear Weapons in Pakistan', *Pakistan Security Research Unit,* (PSRU) (22), November, 18, 2007, at http://spaces.brad.ac.uk:8080/download/att achments/748/Brief_22finalised.pdf (Accessed September 24, 2008).

88 David Blair, 'Code Changes "Secure" Pakistan Warheads', Daily Telegraph, February 9, 2004 as cited in Shaun Gregory, 'The Security of Nuclear Weapons in Pakistan', op.cit.,

are in an unassembled state, the PAL system is not necessary.[89] Hence, there remains significant ambiguity on the claims of Pakistan's code system technology. There has been much speculation on whether the US has transferred such sophisticated technology to Pakistan. Although, Pakistan has always denied the same,[90] such an assertion would indicate lack of integrity since nuclear technology transfer will signify violation of the Non-Proliferation Treaty (NPT) principles. The US would also desist from transmitting technology to Pakistan since it might be susceptible to being relinquished to China.

Even if for the sake of argument, Pakistan's claims are to be believed, there is no method to verify them.[91] 'There is no information on how often the codes are changed and how are they passed down the Pakistan's chain of military command. The operational demands of a sophisticated code system are enormous and one remains doubtful whether Pakistan's delicate technical base can withstand risks of systems breakdown in crisis situation.'[92]

Personnel Reliability Programme

Among the several mentioned threats to Pakistan's nuclear assets, the risk of insider threat has become a cause for considerable international apprehension. The 'precedence of proliferation of sensitive nuclear technology and information by insiders (Pakistani nuclear scientists) to non-nuclear-weapon-states and the suspected nexus between scientists and non-state actors has raised questions on the efficacy of Pakistan's nuclear safety.' Besides the increasing influence of Islamist radicalism within every rank and sphere of Pakistan's establishment including its army threatens the dissolution of the political establishment and leaves

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89 Feroz Hassan Khan quoted in Martin Schram, *Avoiding Armageddon: Our Future, Our Choice,* Basic Books, New York 2003, p.54.

90 'N-assets not open to inspection, says Munir', *Dawn*, February 8, 2004.

91 It is an undeniable fact that any verifying implementation of more advanced security measures is somewhat self-serving. Several legal questions will arise as to who will do the verification and to what standards. Would publishing the results of such verification not provide more information to would-be proliferators?

92 Reshmi Kazi, 'Pakistan's HEU-based Nuclear Weapons Programme and Nuclear Terrorism: A Reality Check', *Strategic Analysis*, Vol. 33, No. 6, November 2009, 867.

nuclear weapons and stocks of nuclear fissile materials exposed to theft.

Despite the above concerns, Pakistan asserts that it carries out a strict selection process of those entrusted with the responsibility of protecting the nuclear assets. Pakistan's command and control system, called the Strategic Command Organisation (STRATCOM) is a three tier structure composing the National Command Authority (NCA), the SPD, and the strategic force commands of the three defence forces. The SPD asserts that it has established a system that requires approval, reporting and monitoring of travel for all scientific personnel and especially those who possess sensitive information or expertise. The SPD maintains vigilance over retired scientists who are retained within Pakistan so that the country can benefit from their expertise. Further steps are taken to ensure that they are not recruited by foreign entities. There are also reports indicating improvement within Pakistan's Personnel Reliability Programme (PRP) for all scientists and officials working on sensitive projects and to that extent has introduced a Human Reliability Programme (HRP) for all military personnel involved with nuclear forces. Former SPD director, Feroz Khan asserted, 'The system knows how to distinguish who is a "fundo" [fundamentalist] and who is simply pious."[93]

However, these assertions are not assuring enough. Recent reports indicate that all is not well within the highly sensitive SPD of Pakistan's nuclear command authority. The SPD is currently facing pressure to be staffed with nominees of politicians and political parties.[94] The practice of making political appointments in such strategic institutions might prove to be extremely dangerous. Allowing such practices would not only bear the consequence of compromising the selection standards

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[93] Daily Times, Lahore July 29, 2007 reports that the SPD has confirmed helping two researchers from an American think-tank in California, Dr Peter Lavoy, and former Pakistani Army Brigadier Feroz Khan, to write a comprehensive account of the country's nuclear programme. As of July 2011 the book has not been published as stated in Pervez Hoodbhoy (ed.), *Confronting the Bomb Pakistani and Indian: Scientists Speak Out,* Karachi, Pakistan: Oxford University Press, 2013, p.197.

[94] Ansar Abbasi, 'SPD also under pressure over political appointments', *The News*, October 1, 2008, at http://www.thenews.com.pk/top_story_detail.asp?Id=17614 (Accessed October 1, 2008).

but will also unfavourably affect the working culture and efficiency of strategic organisations. This in turn can exaggerate the insider threats within the country. Pakistan's assertion that its 'two-person' rule in every action involving nuclear weapons is hardly any defence against individual unreliability and irrationality. Given the level of pervasive corruption within Pakistan,[95] such a two-person rule can be evaded by resolute individuals. Pakistan has a homegrown personnel reliability programme, for its nuclear weapons security but even this could be circumvented in a determined conspiracy.[96] Further, the operations of the Counter-Intelligence (CI) Directorate in the Security Division within the SPD remains classified. Hence, there is no transparency on whether the PRP Directorate conducts periodic psychological testing on its recruits and scientists. There is no verified information asserting without a doubt whether the PRP Directorate has any polygraph systems, or whether those conducting these tests are themselves adequately trained and equipped as security personnel.

There have also been disturbing reports of Pakistani nuclear scientists defecting from the country. In June 1998, *The Observer* reported that five Pakistani nuclear scientists have defected to the West because they objected to being asked to help plan possible nuclear strikes on military targets in India.[97] In November 2001, Pakistan had reportedly sent over two scientists to Myanmar for their alleged links with Al Qaida.[98] In December 2002, nine Pakistani nuclear scientists were reported

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[95] A Transparency International survey of 163 countries based on perceived levels of corruption saw Pakistan slip down two places compared to its ranking of 145 last year, suggesting a rise in corruption. See http://en.wikipedia.org/wiki/List_of_countries_by_Corruption_Perceptions_Index.

[96] 'Pakistan's N-arsenal called risk-prone,' *Daily Times*, June 14, 2008 at http://www.dailytimes.com.pk/default.asp?page=2008\06\14\story_14-6-2008_pg7_13 (Accessed June 16, 2008).

[97] Though the report was described as far fetched since it was very rare for scientists to be allowed abroad, there have been cases of them leaving secretly for better-paid jobs in the West. See 'Pakistan rejects press reports of defections by nuclear scientists', at http://news.bbc.co.uk/2/hi/south_asia/121920.stm (Accessed September 3, 2008).

[98] Myanmar authorities granted sanctuary to two Pakistani nuclear scientists Dr Suleiman Asad and Dr Mohammad Ali Mukhtar following a request from Islamabad. 'Myanmar gives sanctuary to Pak nuke scientists', *Indian Express*, November 23, 2001.

missing from the Chasnupp power plant in Central Pakistan fuelling concerns that the country's nuclear dossiers might fall into wrong hands.[99]

The PRP programme can not work in Pakistan.[100] It primarily faces three grave challenges – fundamentalist extremism; lack of sophisticated technology within its nuclear management system, which makes Islamabad rely more upon the rationality and loyalty of individuals manning sensitive nuclear responsibilities; and the risk of protecting the nuclear weapons and materials and preventing their unauthorised use. In the words of Prof Pervez Hoodbhoy:

> Given the generally sloppy work culture and lack of attention to detail, it is hard to imagine that accurate records have been maintained over a quarter century of fissile material production. So one can be certain that small, but significant quantities of highly enriched uranium have not already made their way out? Given that AQ Khan had successfully arranged for the smuggling of entire centrifuges weighing half a ton each, to keep an open mind on the matter would be wise.[101]

This state of affairs is further exacerbated by the politicisation of the army and the deep sense of dissatisfaction among the officers in lower ranks over the Kashmir issue, which heightens the possibility of executing the nuclear option if its authorisation is delegated beyond the top leadership.

Pakistan's Abysmal Security Culture

In the words of David Albright, '….Pakistan tends to leak vital nuclear information. It's the nature of the system.'[102] The iniquitous A.Q. Khan

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[99] Nuclear engineers and scientists working at the Chasnupp were unhappy with their salaries and other benefits and were thus looking for openings to leave the country quietly. See 'Myanmar gives sanctuary to Pak nuke scientists', *South Asia Tribune*, December 30, 2002–January 2003 at http://www.satribune.com/archives/dec30-jan05-03/PI--_Chasma.htm (Accessed January 3, 2003).

[100] In an interaction with professor Pervez Hoodboy in the Institute for Defence Studies and Analyses, New Delhi on October 23, 2013.

[101] Pervez Hoodbhoy (ed.), *Confronting the Bomb,* op cit., p.198.

[102] 'Pakistan Nuclear Arsenal a US Worry', *LA Times*, November 8, 2007, p 1.

case is the evidence of Pakistan proliferating sensitive nuclear technology to various other countries. Pakistan claims that A.Q. Khan's illicit nuclear material trafficking carried on for over 20 years without the government's knowledge. The A.Q. Khan incident demonstrates the abysmal security culture of Pakistan. The August 2001 incident of the two Pakistani nuclear experts who discussed nuclear weapons sensitivities with bin Laden and al-Zawahiri being let off without any trial or punishment, represents a culture of impunity within Pakistan.[103] Adrian Levy and Catherine Scott-Clark in their latest book *Deception: Pakistan, the United States, and the Secret Trade in Nuclear Weapons,* authoritatively argue that illicit nuclear smuggling persists and that Pakistan's nuclear weapons are not secured. According to a German intelligence service report, Pakistan was 'still secretly buying and just as stealthily selling nuclear weapons technology.' The German report concluded, 'They were buying to sell and it could no longer be hived off as rogue scientists doing the deed.'[104] There is indisputably a conduit existing for the transfer of nuclear weapons flowing from state to non-state actors. Former President Pervaiz Musharraf who worked up massive expenditure on his security arrangement was subject to seven known assassination attempts in which army personnel were implicated. Pakistani investigations of the assassination attempts against President Musharraf in late 2003 imply that they were carried out by military officers in league with the Al Qaida operative Abu Faraj al-Libbi. This raises the disturbing possibility that among the officers charged with guarding nuclear stockpiles the Al Qaida might find people willing to cooperate.[105] The threat of insider sabotage gets more complicated with an increasing wave of Islamist and anti-western sympathies within the army and ISI. Former President Zia-ul-Haq opened the door of the army to Islamists in the late 1970s. Over a period, the strength of

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[103] Pakistan has decided not to press criminal charges against two of its nuclear scientists whose reported contacts with Osama bin Laden stirred fears of nuclear terrorism. Peter Baker and Kamran, 'Pakistan to Forgo Charges Against 2 Nuclear Scientists; Ties to Bin Laden Suspected', *The Washington Post*, January 30, 2002.

[104] Joseph Cirincione, 'The Greatest Threat to Us All', *The New York Review of Books*, 55(3), March 6, 2008.

[105] 'Escaped Musharraf Plotter Was Pakistan Air Force Man', *Agence France Presse*, January 12, 2005; 'Musharraf Al-Qaeda Revelation Underlines Vulnerability: Analysts', *Agence France Presse*, May 31, 2004.

groups like Jama'at-I-Islami (…and…) within the army has significantly increased. Reliable information ascertains that the Jama'at-I-Islami has links with the Al Qaida. In 2011, a brigadier serving in the GHQ was arrested and four other officers were reported to be under investigation for contacts with the radical Islamic group Hizb-ut-Tahrir.[106] These incidents demonstrate the appalling security structure of Pakistan. It appears far from convincing to the international community about the efficacy of Pakistan's nuclear weapons security systems.

The Pakistani Army

The assassination of former Prime Minister Benazir Bhutto significantly corrodes the reliability of the Pakistani army and the security services of the country. It was well acknowledged that Bhutto was facing grave danger to her life and yet the army and the security services did little to protect her, resulting in her assassination. It is also a known fact that Pakistan had to make a choice between joining the US in the war on terror or faceing the risk of 'being bombed back into the stone age'. Therefore, the Pakistani army is actually fighting America's war. The problem takes a complex turn because many of the Pakistani soldiers sympathise with the cause of the Afghan militants. They feel betrayed by the government's abandonment of the Taliban in Afghanistan. It can be assumed that they might fight back with the only weapon they have - more violence.[107]

Increasing grievances within the army are also apparent from the fact that regardless of the US siphoning military support worth a billion dollars per year, the army has achieved derisory success in flushing out terrorists from its soil. On the contrary, evidence shows that the Al Qaida leadership has reorganised its headquarters and training camps along the Pakistan-Afghanistan borders. America has expressed its disapproval over the same. The escalating tensions have only further increased the dissatisfaction within the army. Further, Washington's increasing demands for return of stabilised democracy within Pakistan

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[106] Imtiaz Gul, 'Reinventing the Army', *Newsline*, July 31, 2011 as stated in Pervez Hoodbhoy (ed.), *Confronting the Bomb,* op cit., p. 235.

[107] Reshmi Kazi, 'Pakistan's HEU-based Nuclear Weapons Programme and Nuclear Terrorism: A Reality Check', *Strategic Analysis*, Vol. 33 no. 6, November 2009, p.869.

in ways that would affect the traditional role of the army has been a source of persistent disaffection within it.[108]

Outsider Threats

Pakistan is faces extensive risk of outsider threats. The probability of Pakistan's nuclear sites being attacked by heavily armed Taliban-linked extremists is not theoretical. These extremists have of late made obvious their annoyance with the Pakistani political establishment. They have attempted to disrupt the fragile democratic system as is evident from the bombing of the Marriot hotel in Islamabad on September 21, 2008.[109] These Taliban linked militants are dominating the tribal areas of Pakistan wherein they have a safe haven. In 2007, violent militants 'captured 300 Pakistani soldiers—a substantially larger cohort than is likely to be guarding any particular nuclear weapons depot.'[110] Given Al Qaida's predilection for the acquisition of fissile materials for bomb making it would not be a hypothetical argument that Al Qaida and its allies might seek to attack Pakistani nuclear facilities or seek insider help. Pakistan's nuclear establishment has been a target of attacks by terrorists. In September 2007, for example, a suicide bomb operation carried out in the garrison city of Rawalpindi targeted a bus carrying employees of the Pakistan Atomic Energy Commission (PAEC) on their way to work, killing four PAEC officials and three bystanders, and injuring many more.[111] In August 2008, two suicide bombers blew themselves up at the gates of the Pakistan Ordnance Factories (POF) in the high security town of Wah, killing at least 70 people in what was described as the deadliest attack on a military installation in the country's

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[108] An International Republican Institute poll earlier this month found that one out of two Pakistanis believe the army should have no role in a civilian government. See Graham Allison, 'What About the Nukes?', *Newsweek Web Exclusive*, December 28, 2007 at http://www.newsweek.com/id/82259 (Accessed December 29, 2007).

[109] Suicide bomber blew up 1000 kg explosives killing at least 40 killed and over 250 injured. Raja Asghar, Irfan Raza, Muhammad Asghar and Munawer Azeem, 'Terror tears through capital', *Dawn*, September 21, 2008.

[110] See Matthew Bunn, 'Securing the Bomb 2008', op.cit., p. 36.

[111] Amir Mir, 'Pak Jehadis Target Their ISI Mentors, Kill 33 in Blasts', *Daily News and Analysis*, September 5, 2007.

history.[112] In May 2003, mortar attacks were made by Baloch rebels on a Pakistani nuclear establishment near Dera Ghazi Khan, which reinstated the long perceived threat to nuclear installations by non-state actors.[113]

Pakistan's Command and Control Structures

Pakistan's nuclear assets are headed by a centralised decision-making body. The command and control (C^2) system is placed under the top political heads. However, the civilian leadership has hardly any say on Pakistan's nuclear decision-making process.[114] Technically, Pakistan's nuclear weapons are controlled by the military executives at the top followed by a chain of military officers. Thus, there is lack of civilian participation in the nuclear decision–making process. This in turn prevents any system of checks and balances that is critical for assuring accountability in a country like Pakistan where corruption is evident in all spheres. It is noteworthy that Admiral Mike Mullen publicly charged that the terrorist Haqqani network, which had just carried out a deadly attack on the US embassy in Kabul, operated 'as a virtual arm' of Pakistani ISI[115] and that a former ISI commander was among the leaders of the Ummah Tameer-e-Nau (UTN) network, which sought to help the Al Qaida with nuclear and biological weapons.[116] This poses

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[112] The Tehrik-i-Taliban Pakistan of Baitullah Mehsud claimed responsibility for the attack. Taliban spokesman Maulvi Omar stated that the attacks had been carried out in retaliation of military operations in Bajaur and Swat and warned that such attacks would also be carried out in Karachi, Lahore, Islamabad, Rawalpindi, Peshawar, Mardan, Bannu, Kohat and Swat. See Amjad Iqbal & Mohammad Asghar. 'Taliban claim "credit" for Wah carnage: At least 70 killed, 67 injured in twin suicide blasts', *Dawn*, August 22, 2008.

[113] 'Mortar attack on Pak N-Facility', *Rediff.com,* May 17, 2003.

[114] Credible information shows that former Prime Ministers Benazir Bhutto and Nawaz Sharif were deliberately excluded from Pakistan's nuclear decision-making process while in power. See Shaun Gregory, 'The Security of Nuclear Weapons in Pakistan', *Pakistan Security Research Unit* (PSRU) Brief Number 22, November 18, 2007, at http://spaces.brad.ac.uk:8080/download/att achments/748/Brief_22finalised.pdf (Accessed September 24, 2008).

[115] Elisabeth Bumiller and Jane Perlez, 'Pakistan's Spy Agency Is Tied to Attack on U.S. Embassy', *New York Times*, September 22, 2011 at http://www.nytimes.com/2011/09/23/world/asia/mullen-asserts-pakistani-role-inattack-on-us-embassy.html?pagewanted=all (Accessed March 17, 2012).

[116] David Albright and Holly Higgins, 'A Bomb for the Ummah?', *Bulletin of the Atomic Scientists*, 59 (2) March/April, 2003, pp. 49-55.

fundamental questions on the efficiency of the SPD, which controls nuclear weapons, to be able to eliminate all personnel with extremist sympathies. Is the Pakistani C^2 system competent enough to deal with the risks of 'ideological infiltration and insider collusion' functioning within the nuclear installations? In the absence of any sophisticated and effective PAL system technology, disassembled and dispersed nuclear weapons, which as claimed by Pakistan, can be assembled quickly in crisis times.

There is still hope

Despite the dismal scenario portrayed by the reality check, there is some good news. Pakistan has taken several measures to upgrade its nuclear security. For example, the government announced in June 2007 that it is 'implementing a National Security Action Plan with the [IAEA's] assistance.'[117] In this regard, the Federal government has tasked the Pakistan Nuclear Regulatory Authority (PNRA) with the physical protection of nuclear and other radioactive material.[118] To prevent further proliferation of nuclear-related technologies and materials, Pakistan adopted a new national export controls legislation in September 2004.[119] The US reportedly extended nuclear security assistance to Pakistan soon after the 9/11 tragedy. US assistance to Pakistan, which must adhere to the nonproliferation guiding principles, includes the

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[117] Paul Kerr and Mary Beth Nikitin, 'Pakistan's Nuclear Weapons: Proliferation and Security Issues', *Congressional Research Service*, November 14, 2007 at http://www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA474692&Location=U2&doc=GetTRDoc.pdf (Accessed September 24, 2008).

[118] The PNRA initiated towards the last quarter of 2006 encompasses a five-year National Nuclear Safety and Security Action Plan (NSAP) to establish a more robust nuclear security regime. It seeks capacity building in Pakistan's ability to plan for, respond to, and recover from terrorist incidents in collaboration with relevant governmental agencies. The plan has a wide area of applications related to radiation sources, transport safety, deployment of radiation detection equipment widely, etc. See Mohammed Saleem Zafar, 'Vulnerability of Research Reactors to Attack', *The Henry L Stimson Center*, April 2008 at http://www.stimson.org/southasia/pdf/Saleem%20Zafar%20Paper.pdf (Accessed June13, 2008).

[119] Ibid. This legislation includes a requirement that the government should issue control lists for 'goods, technologies, material, and equipment which may contribute to designing, development, stockpiling, [and] use' of nuclear weapons and related delivery systems. According to an April 2007 presentation by Air Commodore Khalid Banuri, Director of Pakistan's Arms Control and Disarmament Division, the lists, which were issued in October 2005, include items controlled by the Nuclear Suppliers Group.

sharing of best practices and technical measures that can help prevent unauthorised or accidental use of nuclear weapons as well as contribute to physical security of storage facilities and personnel reliability.[120]

Pakistan is cognizant of the threats posed by WMDs and their means of delivery. To safeguards against those threats, Pakistan has expressed its commitment to several international treaties and is determined to pursue its commitments towards non-proliferation under various international instruments like Nuclear Safety Convention, Convention on Physical Protection of Nuclear Material (CPPNM); Chemical Weapons Convention (CWC); Biological and Toxins Weapons Convention (BWC); International Conventions against Terrorism and Global Initiative to Combat Nuclear Terrorism and has been continuously reviewing/tightening its controls over sensitive technology and materials. Pakistan continues to work with the United Nations Security Council Resolution (UNSCR) Committee and other partners at international, regional and sub regional levels for implementation of Resolution 1540.

However, as opined by many experts Pakistan still needs to do much more to deal with future threats involving nuclear attacks. For example, Pakistan is not adequately trained or equipped to deal with fire involving a consignment containing mega curries of radioactive source.[121] Pakistan's isolation within the global nuclear community given its nonproliferation stance prevents the precautionary measures undertaken by Islamabad of being world class standards. Evidently, more needs to be done, with significant external inputs to bring Pakistani nuclear plants performance to a level of excellence and to assure long-term safe plant operations.[122] With adequate external support supplemented

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[120] Joby Warrick, 'U.S. Has Concerns over Security of Pakistan's Nuclear Weapons', *The Washington Post*, November 11, 2007; David Sanger and William Broad, 'U.S. Secretly Aids Pakistan in Guarding Nuclear Arms', *The New York Times*, November 17, 2007.

[121] Abdul Mannan, 'Preventing Nuclear Terrorism in Pakistan: Sabotage of a Spent Fuel Cask or a Commercial Irradiation Source in Transport', in Henry D. Sokolski, ed., Pakistan's Nuclear Future: Worries beyond War, Strategic Studies Institute, January 2008 at http://www.strategicstudiesinstitute.army.mil/pdffiles/pub832.pdf (Accessed April 14, 2008).

[122] Chaim Braun, 'Security Issues Related to Pakistan's Future Nuclear Power Program', in Henry D. Sokolski, ed., Pakistan's Nuclear Future: Worries beyond War, Strategic Studies Institute, January 2008 at http://www.strategicstudiesinstitute.army.mil/pdffiles/pub832.pdf (Accessed April 14, 2008).

with the development of additional nuclear infrastructure and technical capabilities within Pakistan, the performance of the Pakistani nuclear plants could reach levels similar to those of nuclear nations like Taiwan or Korea.

Recommendations

That Pakistan is a nuclear weapons state with a modest stockpile of HEU for military purposes is apparent. The co-existence of political instability and institutional weaknesses in a weak political establishment raises questions about the security of Pakistan's nuclear weapons and materials, particularly, its HEU stockpile. The situation demands a comprehensive and prioritised strategy to diminish the danger of nuclear terrorism within South Asia.

- Pakistan must verifiably be able to improve its security standards to overcome the security threats to its HEU stockpile.
- It must verifiably improve the security of its nuclear weapons and materials sites to meet the IAEA physical protection guidelines.
- Efforts must be made to augment the protection and control of existing HEU stocks.
- Global efforts must be undertaken to develop an effective security culture based on 20 percent equipment and 80 per cent security. Pakistan needs to improve its security culture. Mere house arrest of culprits is not an exemplary solution.
- Efforts towards reducing and gradually eliminating the civilian and military uses of HEU must be undertaken.
- Adequate financial assistance must be extended to retired scientists and other nuclear experts to prevent the risk of terrorists accessing them for their expertise.; they need to be constantly monitored as well.
- Pakistan must also do more to augment its law enforcement and intelligence agencies to thwart the Taliban and its allies attacking locations housing nuclear materials.
- Given the risk of the plausibility of a nuclear terror attack from extremists functioning from Pakistan, a separate department should

be composed with full time responsibility to prevent nuclear terrorism.

- Sting operations can be set up to delay and disrupt transactions and offer authorities opportunities to close in on criminals.
- India and Pakistan must develop strong partnership along the lines of the Global Initiative to Combat Nuclear Terrorism and have genuine exchanges of approach to increase transparency and information sharing.
- The authorities must render official recognition to the risks of sites housing HEU within India and Pakistan.
- The threat of nuclear terrorism can be substantially reduced in South Asia, if India and Pakistan mutually agree to reduce their fissile stockpile.
- The IAEA must promulgate some automatic, default penalties for states that commit serious violation of the non-proliferation rules or transfer sensitive nuclear technologies.
- Pakistan-Afghanistan must try undertaking a joint initiative to combat the risk of nuclear terrorism since the epicentre of the risk is primarily in this region.

Conclusion

There is no straightjacket defence against the danger of nuclear terrorism. However, the risks of nuclear terrorism within South Asia will heighten if the existing trends remain unrestrained. The terrorists were not able to accomplish their objective of acquiring nuclear weapons and materials in the aftermath of the disintegration of the Soviet Union. However, the current political instability in the Afghanistan-Pakistan region proves that terrorists are aspiring to unleash nuclear terror to actualise their goal of securing nuclear weapons or materials. What is urgently required is an institutionalised system with a high-level of guidance based on effective intelligence and supervision to deal with the danger of nuclear terrorism within South Asia.

III Insider Threat: The New Nuclear Threat

There is a lethal proximity between terrorists, extremists, and nuclear weapons insiders.

- Rolf Mowatt-Larssen

The danger of insider threats is emerging as the new nuclear threat. This risk is invariably linked with terrorists seeking fissile materials to build a nuclear device. Several experiments[1] have been conducted, which have established that terrorists do not require a sophisticated nuclear weapons building project of a magnitude as that of the Manhattan Project to develop a nuclear device. A number of government studies have cautioned that a sophisticated terrorist organisation like the Al Qaida can successfully manufacture a crude nuclear bomb, once it gets the requisite fissile material. The objective of the terrorists to acquire fissile materials and weapons becomes linked with the danger of insider threats when reports speak of the interception of smugglers and thieves carrying HEU looking for suitable buyers.[2] The objective of this chapter

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1 See US Congress, Office of Technology Assessment (OTA), Nuclear Proliferation and Safeguards, OTA, Washington, DC, 1977, p. 140, at http://www.princeton.edu/<"ota/disk3/1977/7705/7705.PDF (Accessed August 27, 2008); Joseph Biden, remarks at the Paul C. Warnke Conference on the Past, Present, and future of Arms Control, Washington, DC, January 28, 2004, as cited Graham Allison, Nuclear Terrorism: The Ultimate Preventable Catastrophe, Henry Holt, New York, 2004, p. 95; Dan Stober, 'No Experience Necessary', *Bulletin of Atomic Scientists*, March/April 2003, pp. 57–63.

2 See 'IAEA Releases Latest Illicit Trafficking Database Statistics', at http://un.by/en/news/world/2006/28-08-06-13.html (Accessed June 16, 2008); A few of these incidents involved seizures of kilogram quantities of weapons-usable nuclear material, but most involved very small quantities. Also see 'UN Atomic Watchdog Agency Reports Cases of Illegal Trafficking in Nuclear Materials', *UN News Centre*, at http://www.un.org/apps/news/story.asp?NewsID=21409&Cr=nuclear&Cr1=iaea (Accessed June 16, 2008); the IAEA statement of the incidents, which were reported by the states involved with the Office's Illicit Trafficking Database (ITDB), *UN News Centre*, at http://www.un.org/apps/news/story.asp?NewsID=21409&Cr=nuclear&Cr1=iaea (Accessed June 16, 2008); 'Keeping Tabs on Nuclear Material', *International Herald Tribune*, November 2, 2008.

is to analyse the severity of the danger of insider threats, which can be suitably exploited by terrorists. The chapter will address the motivating factors that are greatly responsible for giving rise to potential insider risk to a nuclear establishment. The author focuses on potential factors that make an attempt to convince the reader about the danger of insider threats as a real concern. Finally, the chapter makes certain recommendations whereby the risk of insider thieves can be mitigated.

What is an insider threat?

The risk of insider threat is present in all organisations. The potential of this threat lies in the act of a trusted employee who might betray his allegiances and obligations to his employer and cause damage or espionage against the employer or the organisation. Insider betrayal can vary from subtle forms of theft or sabotage to more malicious and overt forms of sabotage, vengeance and display of violence at the workplace. In a path-breaking study, through the Department of Homeland Security (DHS), the National Infrastructure Advisory Council (NIAC) defines insider threat as:

> The insider threat to critical infrastructure is one or more individuals with the access and/or inside knowledge of a company, organisation, or enterprise that would allow them to exploit the vulnerabilities of that entity's security, systems, services, products, or facilities with the intent to cause harm.[3]

In coming to this conclusion, the NIAC emphasised on the importance of *access* to an infrastructure's vulnerabilities like the systems itself, facilities or critical information. Access of all people without adequate identification to an organisation's critical facilities increases the chances of potential insider threat to the infrastructure.

Potential actors and motivations

The risk of insider betrayals basically stems from three categories of actors: 1) psychologically-impaired disgruntled or alienated employees;

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[3] Thomas Noonan and Edmund Archuleta, 'The Insider Threat to Critical Infrastructures', *The National Infrastructure Advisory Council's Final report and Recommendations*, April 8, 2008 at http://www.dhs.gov/xlibrary/assets/niac/niac_insider_threat_to_critical_infrastructures_study.pdf (Accessed February 4, 2011), p.11.

2) ideological or religious radicals; and 3) criminals.[4] It is important to identify the categories of actors who can act as potential defectors in order to understand insider actors and their corresponding motivations. A trusted employee can develop a malicious intent due to one or a combination of the below listed factors:

- vengeance for a perceived wrong;
- radicalisation for advancement of religious or ideological objectives;
- unlawful financial gain

Individuals are motivated to resort to malicious actions when there exists in the workplace the following factors:[5]

- growing, exacerbated or unaddressed discontent with their place or value in the organisation;
- recruitment by hostile outside entities or groups;
- infiltration of a malicious actor to a trusted position in an infrastructure operator's staff;
- nuclear industry is affected by workplace trends that currently indicate there will be fewer jobs in the future, and individuals who are employed will be required to have greater technical skills.[6]

Insider betrayals may not necessarily be from individuals who have been directly affected by discontent or perceived injustice from within the organisation. There might also exist within the category of active insiders, a subset of unwitting or passive insiders. These employees may not have a malicious intent even if they are disgruntled for fear of exposure and corresponding consequences. However, unwitting insiders can be easily manipulated for the same reasons and motivations as a willing insider, and coerced to divulge secrets or sensitive information

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4 Ibid, p.14.

5 Ibid.

6 Gerhard R. Eisele, Cameron W. Coates, 'Job Satisfaction, Disgruntlement, and Insider Risk', *Oak Ridge National Laboratory,* at http://info.ornl.gov/sites/publications/files/Pub22716.pdf (Accessed February 4, 2011), p.1.

about the organisation. Often this category of insiders violating the trust of their employers is unaware of the exploitation while being coerced to share information.

Future trends and the danger of insider threats

The world of nuclear weapons is expected to gradually undergo revolutionary changes in the coming decades. The nuclear world is surrounded with debates relating to nuclear disarmament, revamp of the nuclear industry, emergence of new nuclear states, rising proliferation, and spread of nuclear energy. Presumably, the world of nuclear weapons will undergo transformation that will affect issues relating to nuclear weapons in the future, which might increase the risk of potential insider threats.

Nuclear disarmament

President Barack Obama in his historic speech in Prague in April 2009 announced, 'nuclear weapons are the most dangerous legacies of the Cold War' and that 'the US will take concrete steps. ... [to] begin the work of reducing [its] arsenals and stockpiles.'[7] As a follow up to his commitment in April 2010, President Obama and his Russian counterpart President Dmitri A. Medvedev opened a new era in their relationship as they signed the New Strategic Arms Reduction Treaty (START) arms control treaty whereby each side within seven years would be barred from deploying more than 1,550 strategic warheads or 700 launchers.[8] The New START Treaty is historic as it re-establishes as a verification regime[9] and could presumably be a foundation for

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7 'Remarks by President Barack Obama', *The White House*, April 9, 2009 at http://www.whitehouse.gov/the_press_office/Remarks-By-President-Barack-Obama-In-Prague-As-Delivered/ (Accessed February 9, 2011).

8 Peter Baker and Dan Bilefsky, 'Russia and U.S. Sign Nuclear Arms Reduction Pact', *The New York Times*, April 8, 2010 at http://www.nytimes.com/2010/04/09/world/europe/09prexy.html, (Accessed February 3, 2011).

9 The New START Treaty has a verification regime that combines the appropriate elements of the 1991 START Treaty with new elements tailored to the limitations of the Treaty. Measures under the Treaty include on-site inspections and exhibitions, data exchanges and notifications related to strategic offensive arms and facilities covered by the Treaty, and provisions to facilitate the use of national technical means for treaty monitoring. To increase confidence and transparency, the Treaty also provides for the exchange of telemetry. See "New START," US Deaprtment of State at http://www.state.gov/t/avc/newstart/ (Accessed on September 17, 2013).

further reductions later. Though this is far from achieving the goal of nuclear disarmament, it can create a special problem if not addressed timely. Nuclear disarmament will invariably affect the careers of nuclear scientists and experts who have been operating at important positions leaving them susceptible as the targets of terrorists seeking nuclear materials or weapons. After the end of the Cold War, nuclear scientists from the former Soviet Union who were left unemployed, were offered money for their knowledge. This became a matter of great concern. The thousands of unemployed and unpaid former Soviet scientists and engineers and the increasing economic desperation in Russia's 'secret cities'[10] also pose a serious proliferation threat.[11] Today, concerns about proliferation have changed and older weapons workers are vulnerable targets. With terrorism emerging as a priority global concern, today the worry is not so much about a state building a technologically sophisticated nuclear weapons programme but an apocalyptic group wanting fissile materials, a weapon or blueprints. Even a small cadre of technical experts, by providing relevant information, could provide a dramatic breakthrough to a rogue state proliferation programme.[12] There also exists substantial apprehension about the notion of 'moonlighting by modem' whereby scientists and experts provide aid to terrorists and proliferants through advice over email. An unemployed nuclear scientist is a potential insider risk who can compromise his skills and know-how to terrorist groups for financial gains. Preventing this 'brain drain' of sensitive information is a crucial aspect of nuclear safety and security. To counter this proliferation threat

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[10] In the former Soviet Union, many nuclear experts lived in formerly secret 'nuclear cities' where they enjoyed high status, heavily subsidised benefits, and good living standards. Today, these 'nuclear cities' have lost most of their subsidies, have high levels of unemployment, and many young workers who compete for available jobs. See Sharon Weiner, 'Controlling the Proliferation of Nuclear Knowledge from the Former Soviet Union', Security Studies Program Seminar April 26, 2006 at http://web.mit.edu/ssp/seminars/wed_archives06spring/Weiner.htm (Accessed February 3, 2011).

[11] Graham Allison, Matthew Bunn, Ashton B. Carter, Richard A. Falkenrath, John P. Holdren, Joseph S. Nye, 'Defending the United States Against Weapons of Mass Destruction Unpublished Memorandum to the United States Senate', *Memorandum*, 1997 at http://belfercenter.ksg.harvard.edu/publication/2697/defending_the_united_states_against_weapons_of_mass_destruction.html (Accessed February 3, 2011).

[12] Ibid.

it is necessary to take adequate steps for redirecting the older workforce of nuclear weapons experts towards civilian work. The authorities must undertake a comprehensive, multi-pronged approach to address this issue. Sufficient financial assistance must be provided to promote civilian economic development of the secret nuclear cities in Russia. As the world progresses towards the total elimination of nuclear weapons, it is important for authorities and experts to take measures for the rehabilitation of unemployed nuclear weapons workers and scientists to prevent them from becoming sources of insider betrayals.

Emerging Nuclear Powers

While the world is taking small but steady steps towards the difficult but not impossible goal of nuclear disarmament, there is international concern over the problem of emerging new nuclear powers. Way back in the 1990s, US Defence Secretary Les Aspin expressed his concern that 'the new possessors of nuclear weapons may not be deterrable'.[13] His successor, William Perry, warned that the danger of a 'rogue nation' acquiring nuclear arms was 'one of the most serious threats facing the world today.'[14] Emerging nuclear powers like North Korea and Iran pose serious insider threats and consequent dangers of proliferation.

North Korea tested nuclear devices in 2006, 2009 and recently in February 2013, but it is still to produce an operational nuclear bomb. Proliferation experts say it has enough fissile material for up to 10 nuclear weapons.[15] Though experts opine that the North is not yet capable of miniaturising a nuclear weapon to mount it on a missile, it is trying to develop such a warhead. It needs more nuclear testing to develop one. Sources indicate North Korea's ageing fleet of Soviet-era bombers can be deterred by the advanced air forces of regional powers to deliver a nuclear bomb outside the country. However,

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[13] David J. Karl, 'Proliferation Pessimism and Emerging Nuclear Powers', *International Security*, 21(3), 1996/97, pp. 87-88.

[14] Michael Wines, 'Aspin Orders Pentagon Overhaul of Strategy on Nuclear Weapons', *New York Times*, October 30, 1993, p. 8; and Kim Murphy, 'Rogue Nation' or Terrorist Poses Serious Nuclear Threat, Perry Says', *Los Angeles Times*, January 9, 1995, p. A 4.

[15] Jeremy Laurence, 'Is North Korea's nuclear programme a threat?', *Reuters*, January 31, 2011 at http://www.reuters.com/article/2011/01/31/uk-korea-north-nuclear-idUKTRE70U1O920110131?pageNumber=1 (Accessed January 31, 2011).

Washington believes Pyongyang's Long-Range Ballistic Missile (LRBM) programme is moving ahead fast, and that the American mainland could itself come under threat within five years.[16] Security Council diplomats have indicated that China is blocking the release of a report by a UN expert panel on the disclosure of a new and highly sophisticated uranium enrichment plant in North Korea.[17] North Korea is reeling under an economic slump for decades now. According to the state-run think tank, Korea Development Institute (KDI) of Seoul, Pyongyang's economy is expected to shrink due to trade sanctions imposed by South Korea in the wake of the North Korean sinking of the Cheonan warship. The Bank of Korea (BOK) recently estimated that the North Korean economy contracted by 0.9 per cent in 2009 after it expanded by 3.1 per cent in 2008.[18] But the KDI noted that the BOK estimated that the North Korean economy had also contracted by 1.1 per cent in 2006 and 2.3 per cent in 2007, indicating that the North's economy was on a downward trend.[19] North Korea's economic crisis was further aggravated by the growing international sanctions for a series of nuclear and missile tests earlier in 2009. Pyongyang's economy is reeling under the UN sanctions and shrinking inter-Korean trade. The KDI of Seoul indicates that despite good harvests last year on the back of favorable weather conditions, food shortages have continued to plague the North, the KDI said, projecting total grain production will reach about 4.2 million tons in 2009, far less than the 5.13 million tons needed to feed the country's 24 million people.[20] Economic crises, evidence of malnutrition and food shortages have

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16 Ibid.

17 Edith M. Lederer, 'Diplomats say China blocks NKorea nuke report', *The Associated Press*, February 23, 2011 at http://www.washingtonpost.com/wp-dyn/content/article/2011/02/23/AR2011022304558.html (Accessed February 24, 2011).

18 Lee Jung-yoon, 'North Korea faces new economic crisis', *Korea Joongang Daily*, July 07, 2010 at http://joongangdaily.joins.com/article/view.asp?aid=2922822 (Accessed January 24, 2011).

19 See 'Kim's Hungry Regime', *The Wall Street Journal*, February 24, 2011 at http://online.wsj.com/article/SB10001424052748703775704576162420261368098.html?mod=googlenews_wsj (Accessed February 24, 2011).

20 Lee Hyo-sik , "N. Korea Facing Worst Economic Crisis," Korea Times at http://www.koreatimes.co.kr/www/common/printpreview.asp?categoryCode=123&newsIdx=48642 (Accessed September 17, 2013).

severe impact on the common people. Sources indicate that corruption level is high and the effect of the economic catastrophe is faced by the common people leaving many of them vulnerable to act as insider or outsider threats to North Korea's nuclear programme.

In the face of the above economic crisis and an impoverished population, international efforts are being undertaken to force North Korea to dismantle and abandon its nuclear weapons programme, rejoin the Nuclear Non-Proliferation Treaty (NPT), and collaborate with the IAEA. In effecting this denuclearisation process, it is important to take into consideration Pyongyang's nuclear workers and the status of the personnel involved in the country's nuclear weapons programme. North Korean nuclear personnel are likely to number in thousands, including fewer than 100 top-level nuclear scientists and engineers.[21] This is consistent with other estimates that number North Korea's nuclear engineers between 3,000 and 6,000, with 200 key personnel related to its nuclear weapons programme.[22] For the successful denuclearisation of North Korea, the international community must have complete knowledge and information of all the nuclear scientists and engineers at undeclared facilities as well as declared ones in order to redirect them from the nuclear weapons programme to civilian projects and thereby rehabilitate them. The effort to decommission and decontaminate Yongbyon would require more than 100 of North Korea's nuclear personnel for site and facilities characterisation, more than 500 for initial dismantlement, and more than 2,000 for full dismantlement. According to a recent estimate by Ronald K Chesser and Carleton J Phillips, both at Texas Tech University's (TTU) Centre for Environmental Radiation Studies (CERS), an additional staff of fewer than 100 international nuclear personnel would be needed for site and facilities characterisation, a few dozen for initial dismantlement,

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21 Jungmin Kang, 'Redirecting North Korea's nuclear workers', *Bulletin of the Atomic Scientists*, January/ February 2009, p. 51.

22 Ibid. North Korea has trained roughly 6,000 nuclear engineers since the 1950s, including 200 key personnel related to its nuclear weapons programme, according to research associate Choon-Geun Lee of the Science and Technology Policy Institute, who spoke at the 20th International Summer Symposium on Science and World Affairs. A January Congressional Research Service report estimated that there were about 3,000 nuclear scientists and research personnel at Yongbyon.

and a similar number for full dismantlement of the Yongbyon reactor.[23] The project could redirect more than 2,000 of the country's nuclear workers.[24] In a visit to the Yongbyon reactor in February 2008, Siegfried S. Hecker found that North Korea had indicated willingness in redirecting some of its Yongbyon nuclear workers to work on the IRT-2000 reactor, which could be used for research and other purposes, including radioisotope production.[25] The international community must timely direct substantial efforts in rehabilitating the nuclear workforce from the decommissioned Yongbyon reactor. In the absence of suitable measures the unemployed nuclear scientists and workers already affected by the prevailing economic crisis remain potential insider threat. To that extent, the international community must also take suitable measures to redirect workers from the now dismantled Iraq's weapons of mass destruction (WMD) programme so that the risk of insider threat can be circumvented.

Iran's nuclear programme is believed to be at an advanced stage of development. Top American military officials said in April 2010 that Iran could produce bomb-grade fuel for at least one nuclear weapon within a year, but would most likely need two to five years to manufacture a workable atomic bomb.[26] International inspectors said in May that Iran has now produced a stockpile of nuclear fuel that experts say would be enough, with further enrichment, to make two nuclear weapons.[27] According to the information provided by the inspectors, Iran had expanded work at its sprawling Natanz site where it is raising the level of uranium enrichment up to 20 per cent - the level needed for the Tehran Research Reactor (TRR), which produces medical

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[23] Ronald K. Chesser and Carleton J. Phillips, 'Characterization and Foundation for Dismantlement of the Yongbyon Nuclear Facility in the DPRK', U.S.-ROK Workshop on DPRK Nuclear Scientist Redirection, Seoul, South Korea, October 20, 2008.

[24] Jungmin Kang, 'Redirecting North Korea's nuclear workers', *Bulletin of the Atomic Scientists*, January/ February 2009, p.52.

[25] Siegfried S. Hecker, 'Denuclearising North Korea', *Bulletin of the Atomic Scientists*, May/ June 2008, . 64(2) 2, pp. 44-49, 61-62.

[26] 'Iran's Nuclear Program', *The New York Times*, September. 7, 2010 at http://www.nytimes.com/info/iran-nuclear-program/ (Accessed January 24, 2011).

[27] Ibid.

isotopes for cancer patients.[28] Until recently, all of Iran's uranium had been enriched to only 4 per cent, the level required to operate nuclear power reactors. Although, increasing the uranium enrichment level to 20 per cent purity does not capacitate Iran to build a nuclear weapon, it definitely gets Teheran nearer to that target. The inspectors reported that Iran had installed a second group of centrifuges - machines that spin incredibly fast to enrich, or purify uranium for use in bombs or reactors - which could improve its production of the 20 per cent fuel.[29] How does this whet the risk of insider betrayals? Iran is an emerging nuclear power with safety and security measures incomparable to that of the five nuclear weapons states. Iran's nuclear programme is extremely vulnerable to attacks from potential sources. This was evident from the recent disclosure made by Iran to the IAEA inspectors that it plans to unload nuclear fuel from its Bushehr reactor. It was suspected that the reactor was struck by the highly sophisticated stuxnet computer worm that sent Iran's nuclear centrifuges into self-destruction. Though, still under speculation, the malicious and complicated cyber worm attack has raised serious concern about the capability of Iran handling a nuclear programme. According to David Albright, president of the Institute for Science and International Security (ISIS), 'It raises questions of whether Iran can operate a modern nuclear reactor safely…..The stakes are very high. You can have a Chernobyl-style accident with this kind of reactor, and there's lots of questions about that possibility in the region.'[30] According to Mr. Ralph Langner, an independent computer security expert and a former psychologist, '…the attackers took great care to make sure that only their designated targets were hit.'[31] He further discovered that the cyber worm hit its target when it

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[28] However, it is quite ambiguous why Iran is making the investment if it plans to obtain the fuel for the reactor from abroad, as it would under its new agreement with Turkey and Brazil.

[29] 'Iran's Nuclear Program', *The New York Times*, September. 7, 2010 at http://www.nytimes.com/info/iran- nuclear-program/ (Accessed January 24, 2011).

[30] William J. Broad and David E. Sanger, 'Iran Reports a Major Setback at a Nuclear Power Plant', *The New York Times*, February 25, 2011 at http://www.nytimes.com/2011/02/26/world/middleeast/26nuke.html?_r=1&ref=nuclearprogram (Accessed February 25, 2011).

[31] William J. Broad John Markoff and David E. Sanger, 'Israeli Test on Worm Called Crucial in Iran Nuclear Delay', *The New York Times*, January 15, 2011 at http://www.nytimes.com/2011/01/16/world/middleeast/16stuxnet.html?pagewanted=all (Accessed January 15, 2011).

detected 'the presence of a specific configuration of controllers, running a set of processes that appear to exist only in a centrifuge plant.'[32] Although officially, no culpability has been fixed on anyone for deployment of this very sophisticated cyber weapon, it is strongly believed that the virus has been designed as part of an American-Israeli project to sabotage Iran's nuclear programme. According to an American expert on nuclear intelligence, 'To check out the worm, you have to know the machines. The reason the worm has been effective is that the Israelis tried it out.'[33] This lone incident makes experts realise the requirement for increased and improved focus on the 'Insider Threat' to their systems operations. Reports indicate that the worm was initially delivered by a thumb drive. It clearly indicates that an insider from the facility was targeted to introduce the malware to the actual system controller for the attack. A trusted person from within the organisation was armed with this single device so that he could set the chain reaction in motion. It cannot be the job of any ordinary hacker. According to Mr. Langner, it had to be the work of someone who knew his way around the specifics and had an intimate understanding of exactly how the Iranians had designed their enrichment operations.[34] The stuxnet incident also cautions that similar complicated cyberworms exist that can be used for purposes of sabotage with insider assistance.

In the months following the stuxnet cyberworm attack on the Natanz nuclear facility, critical infrastructure in India too was infected by the Israeli tactical cyber weapon. In June 2010, ONGC oil rigs using SCADA (Supervisory Control and Data Acquisition) industrial systems were found to be infected by the same worm.[35] Though the main oil centre, run by ABB was not immediately affected by the cyber worm since it was programmed to target Siemens systems, yet one cannot ignore that it could have infected 247 onshore production facilities, 11 offshore processing complexes, 74 drilling rigs and 7,000 wells, and affected

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32 Ibid.

33 Ibid.

34 Ibid.

35 Sai Manish, 'India is a Sitting Duck in the Cyber Battlefield', *Tehelka Magazine*, Vol 8 Issue 47, November 26, 2011 at http://www.tehelka.com/story_main51.asp?filename=Ne261111India.asp (Accessed April3, 2012).

India's entire oil production for several days, if not weeks.[36] Investigations further revealed that massive infections exist in a mega power project in Gujarat using SCADA systems controlling the generation and transmission network in Western India.[37] Investigators pieced together the evidence and launched a probe into other vulnerable systems that revealed facts that were too sensitive and complex to be made public.[38]

Organisational failure to detect unauthorised access to sensitive information can prove disastrous for national interests. In June 2013, a 29-year-old computer whiz, Edward Snowden working at the National Security Agency, allegedly divulged details about the U.S. electronic intelligence service data-collecting programmes.[39] The whistleblower's actions have been greatly damaging to the US national security. Potential insider threats from emerging nuclear powers pose problems that provide significant reasons to worry. The international community needs to address the problems associated with new nuclear states in order to prevent a nuclear holocaust from happening.

Pakistan's nuclear weapons programme

The danger of insider threats is a strong possibility within Pakistan. The recent assassination of Punjab Governor Salmaan Taseer by one of his elite police guards in Islamabad is another grim reminder of the risks insiders pose to the establishment and the credibility of Pakistan's personnel reliability programme. The assassin Malik Hussain Qadri had been removed from the Special Branch because he was already perceived to be a potential security threat. The question that arises is how was he then recruited to the personal security force of the governor who was already receiving death threats for his support of a Christian woman Aasia Bibi convicted of blasphemy. It is also strange that Qadri fired 41 shots at the governor but was not stopped by the other guards

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36 Ibid.

37 Ibid.

38 Ibid.

39 Snowden who was enlisted in the US army was discharged from the services after breaking his legs in an accident. Reportedly, Snowden was frustrated with the ways privacy intrusions are going at work.

assigned for the same protection duty. Investigations revealed that Qadri had already told his colleagues of his plan and asked them not to open fire. This collusion is a chilling account of the degree of potential insider threats existing within Pakistan. Coll says the Punjab governor's killing was a reminder that one shouldn't be too dismissive of the possibility of a breach in the nuclear security systems by an insider, however remote.[40]

> Taseer's betrayal should give pause to those officials in Washington who seem regularly to express complacency, or at least satisfaction, about the security of Pakistan's arsenal.[41]

The recent Wikileaks' disclosures revealed similar concerns expressed by the former US Ambassador to Pakistan Anne W. Patterson about the possibility of subversion in the safety and security of Pakistan's nuclear weapons. Patterson in a February 2009 briefing for special envoy for Afghanistan and Pakistan, Richard Holbrooke, stated 'Our major concern is not having an Islamic militant steal an entire weapon but rather the chance that someone working in GOP facilities could gradually smuggle enough material out to eventually make a weapon.'[42]

There have also been disturbing reports of Pakistani nuclear scientists defecting from the country. In June 1998, *The Observer* reported that five Pakistani nuclear scientists had defected to the West because they objected to being asked to help plan possible nuclear strikes on military targets in India.[43] In November 2001, Pakistan had reportedly sent

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40 'Pakistan's nuclear weapons and the enemy within', *Reuters*, January 6, 2011 at http://blogs.reuters.com/afghanistan/2011/01/06/pakistans-nuclear-weapons-and-the-enemy-within/ (Accessed January 13, 2011).

41 Steve Coll, 'An Assassination in Pakistan', *The New Yorker*, January 4, 2011 at http://www.newyorker.com/online/blogs/newsdesk/2011/01/an-assassination-in-pakistan.html#ixzz1A62ctsrN (Accessed February 13, 2011).

42 'US embassy cables: Punjab, ISI and a distracted president trouble Pakistan', *Guardian*, November 30, 2010 at http://www.guardian.co.uk/world/us-embassy-cables-documents/190330 (Accessed February 13, 2011).

43 Though the report was described as far-fetched since it was very rare for scientists to be allowed abroad, there had been cases of them leaving secretly for better paid jobs in the West. See 'Pakistan Rejects Press Reports of Defections by Nuclear Scientists', at http://news.bbc.co.uk/2/hi/south_asia/121920.stm (Accessed September 3, 2008).

over two scientists to Myanmar for their alleged links with Al Qaida.[44] In December 2002, nine Pakistani nuclear scientists were reported missing from the Chasnupp power plant in Central Pakistan, fuelling concerns that the country's nuclear dossiers might fall into the wrong hands.[45]

Pakistan also faces the substantial risk of malicious insiders working with outsiders seeking information and materials in their quest for a bomb. In fact, growing extremism in Pakistan increases the odds of insiders in the nuclear establishment collaborating with outsiders to access weapons, materials, or facilities.[46] The possibility of Pakistan's nuclear sites being attacked by heavily armed Taliban-linked extremists is not hypothetical. These extremists have of late expressed their displeasure with the Pakistani civilian government. They have attempted to disrupt the fragile democratic system, as is evident from the bombing of the Marriot Hotel in Islamabad on September 21, 2008.[47] These Taliban-linked militants are dominating the tribal areas of Pakistan wherein they have a safe haven. In 2007, violent militants 'captured 300 Pakistani soldiers – a substantially larger cohort than is likely to be guarding any particular nuclear weapons depot.'[48] Given Al Qaida's interest in acquiring nuclear materials for bomb-making, it would not be far-fetched to argue that Al Qaida and its allies might attempt to attack Pakistani nuclear facilities or seek insider assistance.

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44 Myanmar authorities granted sanctuary to two Pakistani nuclear scientists, Dr. Suleiman Asad and Dr. Mohammad Ali Mukhtar, following a request from Islamabad. 'Myanmar Gives Sanctuary to Pak Nuke Scientists', *Indian Express*, November 23, 2001.

45 Nuclear engineers and scientists working at Chasnupp were unhappy with their salaries and other benefits and were thus looking for openings to leave the country quietly. See 'Myanmar Gives Sanctuary to Pak Nuke Scientists', *South Asia Tribune,* December 30, 2002 – January 5, 2003 at http://www.satribune.com/archives/dec30jan0503/PI_Chasma.htm (Accessed January 3, 2003).

46 Rolf Mowatt-Larssen, 'Nuclear Security in Pakistan: Reducing the Risks of Nuclear Terrorism', *Arms Control Today*, July/August 2009.

47 A suicide bomber blew up 1,000 kg of explosives, killing at least 40 and injuring over 250. Raja Asghar, Irfan Raza, Muhammad Asghar, and Munawer Azeem, 'Terror Tears through Capital', *Dawn*, September 21, 2008.

48 Matthew Bunn, 'Securing the Bomb 2008', *Belfer Center for Science and International Affairs*, Harvard University, November 2008, p. 36.

Further, Steve Coll in a blog on *The New Yorker* posted comments:

> Pakistan's Personnel Reliability Programmes (PRP), as they are known in the nuclear security trade, involve not only evaluating the suitability of bodyguards for governors but also the management of the country's swelling stockpile of fissile materials and nuclear bombs.[49]

The fear of the insider is ubiquitous and well founded.[50] It is difficult to find another example where the defence apparatus of a modern state has been rendered so vulnerable by the threat posed by military insiders.[51]

Coll further expresses concern over Pakistan's growing nuclear stockpile, which is under the lock and key of the military. According to the estimates of Professor R. Rajaraman and his colleagues of the International Panel on Fissile Material (IPFM), by 2020 Pakistan will be presumably in possession of 450 kg of plutonium – enough for 90 bombs, and 2500 to 6000 kg of 90 per cent HEU, sufficient for approximately 100 to 420 simple fission weapons.[52]

Pakistan's expanding nuclear arsenal is another troubling factor, which indicates that insider threats are not mere anomalies. Pakistan's nuclear arsenal roughly doubled from 1998 to today's total of a hundred weapons, in round numbers.[53] In the coming years, as new plutonium-production capacity at the Khushab site comes online, the total number of nuclear weapons could increase dramatically.[54] An expanding nuclear

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[49] Steve Coll, 'An Assassination in Pakistan', *The New Yorker*, January 4, 2011 at http://www.newyorker.com/online/blogs/newsdesk/2011/01/an-assassination-in-pakistan.html#ixzz1A62ctsrN (Accessed February 13, 2011).

[50] Pervez Hoodbhoy (ed), *Confronting the Bomb: Pakistani and Indian Scientists Speak Out*, (Karachi, Pakistan, Oxford University Press, 2013), p.172.

[51] Ibid., p.174.

[52] Zia Mian, A. H. Nayyar, and R. Rajaraman, 'Exploring Uranium Resource Constraints on Fissile Material Production in Pakistan', *Science and Global Security*, 17, 2009, pp,77–108.

[53] Heather Maher, 'Expert Says Pakistan Improving Quality of Nuclear Arsenal', Radio Free Liberty Radio Europe, www.rferl.org/content/Expert_Says_Pakistan_Improving_Quality_Of_Nuclear_Arsenal/1736019.html. (Accessed January 3, 2010).

[54] Ibid.

arsenal would require increased material, more infrastructure like additional construction of facilities for processing material and manufacturing weapons and delivery systems, and further demands for storage of waste and transportation. This creates the possibility for increased vulnerabilities and more areas for things to go wrong. This situation can increase the 'potential pathways' to the bomb for the terrorists. When this state of affairs is seen in the broad perspective of increasing political instability prevailing in Pakistan, it appears not only complicated but also as a situation difficult to counter.

Pakistan's vigilance over its nuclear arsenal has always remained questionable. Thomas Fingar, a former chairman of the National Intelligence Council (NIC) and deputy director of national intelligence under President George W. Bush, said that it is logical that any nuclear-weapons state would budget the resources necessary to protect its arsenal, but 'we do not know that this is the case in Pakistan'.[55] The key concern, Fingar says, is that 'we do not know if what the military has done is adequate to protect the weapons from insider threats, or if key military units have been penetrated by extremists. We hope the weapons are safe, but we may be whistling past the graveyard.'[56]

There is enough credible information to claim that at least some Pakistani military men are known for their sympathy extremist terrorist groups. Recently, a brigadier, Ali Khan, was arrested for allegedly maintaining contact with a banned extremist organisation.[57] Almost simultaneously, militants invaded a major Pakistani naval base near Karachi, blowing up two P-3C Orion surveillance planes and killing at least 10 people on the base.[58] It is believed that the naval base houses critical nuclear-weapon components nearby. In a series of interviews, several Pakistani officials told that investigators believe the militants had help inside the base.[59] A retired Pakistani general with intelligence experience says,

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55 Jeffrey Goldberg and Marc Ambinder, 'The Ally From Hell', *Atlantic Magazine*, December 2011 at http://www.theatlantic.com/magazine/archive/2011/12/the-ally-from-hell/8730/ (Accessed December 29, 2011).

56 Ibid.

57 Ibid.

58 Ibid.

59 Ibid.

'Different aspects of the military and security services have different levels of sympathy for the extremists. The navy is high in sympathy.'[60]

Nuclear power and the risk of nuclear proliferation

Increasing demand for energy requirement worldwide has surged interest in nuclear energy. 30 states operate one or more nuclear power plants today, and according to the IAEA, 50 others have requested technical assistance from the agency to explore the possibility of developing their own nuclear energy programmes.[61] This renaissance in nuclear power will lead to the development of more nuclear technology globally. However, the spreading of nuclear renaissance has raised mounting concerns of nuclear proliferation. It gives rise to questions like- will the growth of nuclear power lead to increased risks of nuclear weapons proliferation and the consequent danger of nuclear terrorism. One crucial requirement for nuclear energy programmes to be developed and controlled safely and securely is that the states have domestically good governance that facilitates proper nuclear operations and management. Democratic functioning of the state will provide lesser degree of corruption and increased political stability. Unfortunately, these characteristics are conspicuously absent in Pakistan. There is documented evidence of officials selling materials, technology and expertise for their personal interest as occurred with the AQ Khan black-market network. Yet, Pakistan is forging ahead with China for civil nuclear cooperation, thereby increasing pathways to the bomb for terrorists. Proper management of nuclear energy programmes can be safely conducted in those states that are secure from terrorist attacks. For a state that is confronted with incessant threats from within is severely challenged in circumventing terrorist attacks on nuclear facilities or no diversion of fissile materials to terrorists in pursuit of a bomb. Pakistan's nuclear establishment has been a target of attacks by militants. The Indo-US Civil Nuclear Cooperation Deal of July 2005 has also raised concerns about the proper management of nuclear energy industry owing to the series of terrorist attacks in India. Concerns about proliferation exist at the intersection of nuclear power and nuclear

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[60] Ibid.

[61] Steven E. Miller & Scott D. Sagan, 'Nuclear power without nuclear proliferation?', *Dædalus*, 2009, p.7.

weapons. Expanding nuclear energy obviously will require more infrastructure and nuclear materials, thus opening ways for potential insiders to divert nuclear materials and information. Minimising the proliferation risks associated with expansion of nuclear energy must be prioritised in order to prevent a dangerous nuclear future.

Dynamic changes within the nuclear industry

In the immediate future, the nuclear industry is expected to undergo dynamic changes due to workplace trends that will lead to fewer jobs. The employees who will be retained will require greater technical skills. This reshaping of the workforce will be a necessity to replace an aging workforce and for increased diversity within the work environment. This can have two effects. First the reshaping will increase the demands for greater productivity and employee expectations in terms of remuneration and/or benefits. If employee satisfaction is not realised, there is a real possibility of potential disgruntled employees who might turn into 'insider risk' to the organisation.[62] The second effect will be the unemployed workforce who if not redirected into alternative jobs or rehabilitated might emerge as potential insider threat and a new nuclear danger.

Global nuclear materials lockdown to take longer than four years

President Obama's aim of securing all the loose fissile material is likely to take longer than the set target of four years. Though the US administration along with its international partners is a focused four years effort, it seems unlikely that all nuclear materials can be secured by 2013. A Government Accountability Office (GAO) report issued in December 2009 found a number of flaws with the administration's efforts to achieve the four years plan, including a lack of specific details concerning the initiative's implementation and questions on which sites would be addressed.[63] The overall schedule was also unclear as stated

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[62] Gerhard R. Eisele, Cameron W. Coates, 'Job Satisfaction, Disgruntlement, and Insider Risk', *Oak Ridge National Laboratory* at http://info.ornl.gov/sites/publications/files/Pub22716.pdf (Accessed February 4, 2011), p.1.

[63] Martin Matishak, 'Global Nuclear Materials Lockdown to Take Longer Than Four Years,' *Global Security Newswire*, February 22, 2011 at http://gsn.nti.org/gsn/nw_20110222_2593.php, (Accessed February 23, 2011).

by the congressional auditors.[64] Various US threat reduction programmes had secured roughly 20 sites around the world that contained thousands of kilograms of atomic material.[65] In addition, 40 buildings and sites inside Russia have also been secured.[66] Moscow has also helped to safeguard two tons of weapon-grade uranium removed from Ukraine and other countries.[67] Yet, some states like Belarus remain a risk. Experts estimate, Belarus possesses between 375 pounds and 815 pounds of highly enriched uranium, including 90 pounds that has been enriched to the 90 per cent level required to fuel a warhead.[68] These unsecured weapons grade nuclear materials remain an attractive option for terrorists seeking to build a bomb and there will always remain a lethal connection between them and nuclear weapon insiders to gain access to the fissile materials.

A weapons scientist

According to the IAEA, the Iranian nuclear programme was provided critical technical help by an outside expert, identified by other sources as Vyacheslav Danilenko, a researcher who, until 1989, had worked for three decades at a leading Soviet nuclear weapons research and design institute.[69] Although, Danilenko has denied providing any such help to Iran, yet this issue involving a weapons scientist raises reasonable fear. A weapons scientist is any person who has worked at an institute with some WMD function, and who is old enough to have been employed during Soviet times.[70] Since the disintegration of Soviet Union, the US and the rest of the international community feared that poor ex-Soviet nuclear scientists would turn into would-be proliferators selling their weapons of mass destruction skills to potential buyers. This effort has

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64 Ibid.

65 Ibid.

66 Ibid.

67 Ibid.

68 Ibid.

69 Sharon K. Weiner, 'Who's a weapons scientist?', *Bulletin of the Atomic Scientists*, November 16, 2011 at http://www.thebulletin.org/web-edition/features/whos-weapons-scientist (Accessed November 20, 2011).

70 Ibid.

expanded to Iraq and Libya, and some in Washington hope to include North Korea and one day Pakistan.[71]

Proliferation Pathways

Proliferation networks unless substantially neutralized can prove to be a potential source which can be likely tapped by terrorists seeking nuclear materials and weapons. The AQ khan network proved to be an effective proliferation pathway and successfully provided sensitive technology and materials including centrifuges to several buyers. There are several products that are bought and sold in the proliferation pathways. The key elements that are traded in such networks include

- Technical information, blue-prints and research
- Nuclear component parts, precursors and dual use technology related to nuclear weapons
- Nuclear bombs
- Nuclear materials
- Gas centrifuges
- Nuclear reactor couples with a plutonium separation plant
- Laser enrichment of uranium
- Trigger devices
- Precision tools
- Missile and missile-warhead guidance systems
- Delivery systems

Proliferation pathways remain a lucrative source for terrorists aspiring to achieve nuclear capability.

Incidents of insider threat

Apart from the incidents of a group of peace activists breaching the perimetre fence at Kleine-Borgel airbase in Belgium in early February

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[71] Ibid.

2010, and the breaching of the Pelindaba nuclear facility in Pretoria, South Africa, which have been discussed in detail earlier, there was the case of a husband and wife team that was arrested in New Mexico September 2010 and accused of passing nuclear information to an FBI agent posing as a Venezuelan spy.[72] US citizens Pedro and Marjorie Mascheroni were contractors at Los Alamos National Laboratory, a centre of US nuclear research. The team had access to nuclear secrets, including material on the design and manufacture of nuclear weapons. Mr. Mascheroni allegedly said that he could help Venezuela develop a nuclear bomb within 10 years and a nuclear energy programme, and described a potential 'umbrella' deterrent strategy for the Latin American nation.[73]

In South Asia, there have been several cases of insider threats as well. Perhaps the most gruesome example of insider threat was the assassination of the Indian Prime Minister Indira Gandhi by her own Sikh bodyguards in November 1984 towards the end of Sikh separatist insurgency. Several other reported incidences of smuggling of fissile material in India and in the subcontinent indicate the involvement of potential risk of insiders. Since 1993, nine trafficking cases involving uranium ore and LEU have been recorded in India, one in Bangladesh, and another in Pakistan.[74] In November 2009, a disgruntled worker at the high-security Kaiga nuclear power plant laced the office drinking water with tritium (a radioactive isotope). Fifty-five employees were administered emergency medical treatment after they drank the contaminated water. The government said that the contamination of the water was deliberate and India's security services were called in to investigate. 'The incident appears to be the handiwork of a disgruntled employee,' said Prithviraj Chavan, the Science Minister and added that the government was taking the issue very seriously as it was a 'breach

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72 Paul Adams, 'US couple tried to pass nuclear secrets to Venezuela', *BBC News*, September 17, 2010 at http://www.bbc.co.uk/news/world-us-canada-11351535, (Accessed October 1, 2010).

73 Ibid.

74 See *Nuclear Black Markets: Pakistan, Khan and the Rise of Proliferation Networks*, International Institute for Strategic Studies, 2007, p. 130.

of some security measures'.[75] Anil Kakodkar, chairman of the Indian Atomic Energy Commission, said the contamination was an 'inside job'.[76] He added, 'Someone has deliberately done this'.[77] These incidents are worrisome pointers especially when India has embarked on a large building programme of atomic reactors, after signing the civil nuclear energy deal in July 2005.

In Pakistan, perhaps the greatest insider threat was posed by A.Q. Khan himself when he with further insider assistance was able to hand over centrifuges, nuclear technology and blueprints to Iran, Libya, and North Korea. The scale of the insider threat problem is daunting in Pakistan. According to Lt. Gen. Kidwai there is approximately 70,000 people work in the nuclear complex in Pakistan, including 7,000 to 8,000 scientists, of which approximately 2,000 have 'critical knowledge'.[78] Further an anonymous US official reportedly expressed concern over what he believed to be 'steadfast efforts of different extremist groups to infiltrate the labs and put sleepers and so on in there.'[79] A particular challenge for Pakistan will be keeping track of the growing number of retired scientists and other personnel with sensitive knowledge.[80]

In November 2011, a Chinese citizen Xun Wang, a law abiding US permanent resident in California pleaded guilty to conspiring to ship material for the Pakistani Chashma II nuclear reactor after initially denying that she was behind any scheme contributing to the proliferation threat. Wang was accused of conniving to send high-performance epoxy coatings to the Chashma II nuclear reactor in three shipments

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75 Rhys Blakely, 'Water-cooler moment of horror as disgruntled worker poisons colleagues', *The Sunday Times*, December 1, 2009 at http://www.timesonline.co.uk/tol/news/world/asia/article6937394.ece (Accessed December 1, 2009).

76 Ibid.

77 Ibid.

78 David E. Sanger, 'What to Do about Pakistan's Nuclear Arsenal?', *New York Times Magazine*, January 8, 2009. Given the large number of people working 'in the nuclear complex' it seems reasonable that only a much smaller subset with access to sensitive materials is subject to the HRP or PRP.

79 Ibid.

80 Kenneth N. Luongo and Brig. Gen. (Ret.) Naeem Salik, 'Building Confidence in Pakistan's Nuclear Security', *Arms Control Today*, December 2007.

from the US to Pakistan through a third-party distributor in China without the required license from the Commerce Department.[81]

Recommendations

The danger of insider threat is a global problem that has to be addressed by all the leading partners of the international community. It is important for the nuclear institutions and organisations to become wiser to the tactics of potential insiders. This threat cannot be assessed in isolation. While taking adequate steps to secure fissile materials worldwide, substantial efforts must be made to overhaul the personnel reliability programme, which must transcend beyond mere evaluation of the suitability of bodyguards to the management of expanding stockpile of nuclear materials and weapons. As part of these comprehensive efforts, certain recommendations are listed below to deal with the insider threat:

- Stabilise the economic status of the nuclear personnel in order to prevent nuclear scientists, engineers, workers and guards from stealing nuclear weapons and materials or selling nuclear knowledge;
- Redirect the aging workforce into civil nuclear programmes and thereby, provide them alternative employment;
- Provide tax benefits to nuclear workers staying in now defunct secret nuclear cities;
- Efforts to ensure a secure retirement for nuclear experts and workers;
- Take steps to ease the decommissioning of nuclear reactors to avoid risks of leakage and proliferation;
- Improve procedure for personnel screening of employees. Pre-recruitment background checks must be done to check prior criminal records. Establishments must enforce strict password and account passwords to prevent the entire procedure from getting

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[81] 'Woman pleads guilty to illegal export to Pakistan', *Daily Times*, November 17, 2011 at http://www.dailytimes.com.pk/default.asp?page=2011%5C11%5C17%5Cstory_17-11-2011_pg7_32, (Accessed November 18, 2011).

circumventing. Effective steps must be undertaken to secure the personal reliability programme and human reliability programme;

- Research must be conducted on insider threats in the context of globalisation and on the effects of outsourcing;
- Expand capabilities of nuclear forensics, police force and human intelligence to intercept nuclear thieves;
- Developing effective security awareness programmes that clearly communicate that any security breach will be met with appropriate disciplinary action including termination of services. Sanctions must also be enforced;
- The international community must take steps to ensure that every major port shipping cargoes has advanced technologies and training equipment to inspect it;
- Strengthening international nuclear emergency search and response capabilities;
- Broad dialogue with countries like Russia, Pakistan, Belarus and North Korea for circumventing the threat of potential insider risk.

The danger of insider threat must be managed with intelligence, and technology through a defence-in-depth strategy. If the systems are maintained according to the security configurations necessary, duties are segregated, accounts and passwords are controlled, and employees are made aware that their actions are being logged and monitored, there is less likelihood that a disgruntled employee will attempt any unwanted activity.[82] On the other hand if the management is not involved and the systems are wide open, there may be a perception that getting caught is less likely. Though most employees and contractors are trustworthy and contribute towards the betterment of the organisation, yet unexpected, disappointments can occur that can subvert a trusted employee to resort to criminal activities. To avoid a nuclear catastrophe, substantial measures should be built into the security programmes to counter the insider threat. In response to fears that malicious acts could

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[82] Todd Fitzgerald, 'The Insider Threat: A View from the Outside', at http://www.infosectoday.com/Articles/The_Insider_Threat.htm, (Accessed on February 27, 2011).

be carried out by 'insiders' - staff with authorised access to nuclear facilities - workshops and documents are being developed to help countries assess the threat [provisions have been undertaken to] guard against insider theft of nuclear material and sabotage.[83] The IAEA is coordinating the project, which is a bilateral initiative between the USA and France.[84] In order to adequately deal wit the threat of cyber attacks on nuclear facilities, the IAEA is finalising guidelines on the *Security of Information Technology Related Equipment and Software Based Controls Against Malevolent Acts*.[85]

The threat of cyber risks to nuclear security is real. It is perhaps the newest and most complex threat happening. Hence, it is critical to develop combat mission forces to react responsibly to the emerging threat of cyber attacks.

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83 'Cyber & Insider Threats Among Targets of Nuclear Security Measures', IAEA General Conference, September 24, 2004 at http://www.iaea.org/newscenter/news/2004/cyberthreats.html, (Accessed February1, 2013).

84 Ibid.

85 Ibid.

IV Nuclear Forensics: The Way Forward*

In a strange turn of history, the threat of global nuclear war has gone down, but the risk of a nuclear attack has gone up.

President Barack Obama
Prague, April 5, 2009

The danger of nuclear terrorism and ways to thwart it, tackle it, and manage it in the event of an attack is increasingly gaining the attention of nuclear analysts all over the world. In the post 9/11 period, with nuclear terrorism emerging as foremost among the gravest threats to global peace and security, there has been a conscious awareness among the world leaders to develop mechanisms to prevent, deter and deal with the threat of nuclear terrorism. The Nuclear Forensics and Attribution Act 2008, specifically states, '…in order to identify special nuclear material and other radioactive materials confidently, it is necessary to have a robust capability to acquire samples in a timely manner, analyze and characterize samples, and compare samples against known signatures of nuclear and radiological material.'[1] The critical importance of effective nuclear forensics application was highlighted in the recent 2012 Nuclear Security Summit held in Seoul. The Summit Members 'recognise[d] that nuclear forensics can be an effective tool in determining the origin of detected nuclear and other radioactive materials and in providing evidence for the prosecution of acts of illicit trafficking and malicious uses.'[2] In the Seoul Communiqué, Member States 'encouraged

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* Parts of this work have been published as a commentary by the author. See 'Efficacy of Nuclear Forensics', *Strategic Analysis*, Vol. 35, no. 4, July 2011, 576–580

1 H.R. 2631 (110th): Nuclear Forensics and Attribution Act, 110th Congress, 2007–2009. Text as of Sep 27, 2008 (Passed the Senate (Engrossed) with an Amendment) at http://www.govtrack.us/congress/bills/110/hr2631/text (Accessed January 3, 2013).

2 'Seoul Communiqué: 2012 Seoul Nuclear Security Summit', *Nuclear Security Summit Seoul 2012* at http://www.thenuclearsecuritysummit.org/userfiles/Seoul%20Communique_FINAL.pdf (Accessed April 4, 2012).

states to work with one another, as well as with the International Atomic Energy Agency (IAEA), to develop and enhance nuclear forensics capabilities."[3] In this regard, suggestions have been put forward to states 'to combine the skills of both traditional and nuclear forensics through the development of a common set of definitions and standards, undertake research and share information and best practices, as appropriate. We also underscore the importance of international cooperation both in technology and human resource development to advance nuclear forensics."[4]

In the aftermath of a nuclear explosion, there is a host of clues, though the clues are at a microscopic level like crystal structures and impurities, which can enable nuclear inspectors to conclude where the nuclear device or atomic material came from. There has been a consistent effort on the part of nuclear experts to develop and improve the science of nuclear forensics, which could provide faster analysis during a crisis.

The aim of this chapter is to reiterate the importance of nuclear forensics in playing the role of a detective to trace illicit special nuclear materials in the fight against trafficking in nuclear and radiological materials. The author makes an effort in this chapter to emphasise that a competent nuclear forensic programme can help in providing clues to attribution. An effective nuclear forensic and attribution strategy can provide national policy makers, decision makers and technical managers with relevant guidance for responding to situations involving interception of special nuclear materials. The chapter finally concludes by making recommendations that can be considered to develop, design and improve a robust nuclear forensic science that can act as a credible deterrence and a way forward against any nuclear holocaust.

Nuclear Forensics and Nuclear Attribution

Nuclear forensics provides conclusive answers to the problems of attribution. Hence, these terms are interrelated. For purposes of this study nuclear attribution has been defined as:

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[3] Ibid.

[4] Ibid.

"Nuclear attribution is the integration of all relevant forms of information about a nuclear smuggling incident into data that can be readily analysed and interpreted and that forms the basis of a confident response to the incident. The goal of nuclear attribution is to answer policy makers' needs, requirements and questions in their framework for a given incident."[5]

'Nuclear forensics is the analysis of intercepted illicit nuclear or radioactive material and any associated material to provide reliable evidence for the purpose of nuclear attribution. "The goal of nuclear forensics analysis is to identify attribution indicators in interdicted nuclear and radiological samples or its surrounding environment, e.g., the container or transport vehicle. These indicators arise from known relationships between material characteristics and illicit activity." Thus nuclear forensic analysis includes the characterisation of the material and correlation with its production history.[6]

Nuclear attribution and nuclear forensics can be applied to nuclear and radiological materials. Thus, they have been used interchangeably in this chapter. Nuclear forensics with high reliability reaches certain conclusions but those may not be sufficient to uniquely identify the source. The more extensive the databases and libraries of sample materials and associated isotopic analyses are, the more specific the attribution.[7]

Nuclear Terrorism: An Emerging Real Threat

There has been a rise in the number of cases of reported nuclear smuggling since 1991. Although many of these cases are fraud, there has been a corresponding increase in the number of cases believed to

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5 M.J. Kristo, D.K. Smith, S. Neimeyer, G.B. Dudder, 'Model Action Plan for Nuclear Forensics and Nuclear Attribution', International Atomic Energy Agency, March 5, 2006 at http://www.llnl.gov/tid/lof/documents/pdf/305453.pdf (Accessed July 3, 2010), p. 3.

6 Ibid.

7 'Nuclear *Forensics*: Role, State of the Art, Program Needs', *Advancing Science Serving Society*, at http://iis-db.stanford.edu/pubs/22126/APS_AAAS_2008.pdf *(Accessed November 30, 2012), p.13.*

be true or in which material was actually seized.[8] As of December 31, 2005, the Illicit Trafficking Database (ITDB) has recorded a total of 823 confirmed events involving trafficking in nuclear and other radioactive material.[9] Of those cases, 260 involved nuclear material.[10] The number of confirmed nuclear trafficking incidents was highest in 1993-94.[11] Between 1995 and 2002, the number of such incidents was considerably lower, showing a general declining trend, but in 2003–04, it increased again.[12] In addition to confirmed cases of nuclear trafficking, more than 120 incidents, which are yet to be confirmed, allegedly involved nuclear material.[13] There has also been a rise in the number of countries seeking nuclear materials, blueprints, equipment and technology. These countries are accessing the nuclear black-markets for illegal procurement of nuclear expertise and materials. In addition, the terrorist attacks of September 11, 2001 have focused world attention on terrorist groups, their aims, and their methods. For example, captured Al Qaida documents showed serious research into the feasibility of obtaining or developing nuclear and Radiological Dispersion Device (RDD) weapons.[14] In 1995, a Chechen rebel leader directed a Russian television crew to a container with a small amount of 137Cs, presumably as a warning of potential RDD attacks in the future.[15] There have been some sporadic incidents of trafficking of nuclear materials in and around India. In August 2003, three radioactive

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8 'The Nuclear Black Market', CSIS Task Force Report, Center for Strategic and International Studies, chaired by W. H. Webster, 1996.

9 Nuclear Forensics Support, *IAEA Nuclear Security Series No 2*, International Atomic Energy Agency, Vienna 2006 at *www-pub.iaea.org/MTCD/publications/PDF/Pub1241_web.pdf (Accessed July 4, 2010).*

10 Ibid.

11 Ibid.

12 Ibid.

13 Ibid.

14 D. Albright, 'Al Qaeda's Nuclear Program: Through the Window of Seized Documents', Policy Forum Online, no. 47, Nautilus Institute, November 6, 2002 at http://www.nautilus.org/fora/Special-Policy-Forum/47_Albright.html (Accessed October 2, 2008).

15 'Chronology of Nuclear Smuggling Incidents', Federation of American Scientists web-site at http://www.fas.org/irp/cia/product/go_appendixa_032796.html, November 23, 1995 (Accessed October 2, 2008).

isotopes of Cobalt-60 were reportedly found missing from the heavily secure Tata Iron and Steel Company (TISCO) in Jamshedpur. From the Coal Mines Planning and Designing India Limited (CMPDL) complex in Ranchi, Jharkahand in December 2006, a uranium-based ash analyser was stolen.

Orphan sources can also serve the sinister purposes of nuclear black marketers and their clients. Orphaned sources are abandoned radioactive sources that are not adequately accounted for by their legitimate owners. The Cobalt-60 incident in New Delhi in May 2010 is an example of orphan radioactive substance that led to the death of one person and left several critically ill.

What can Nuclear Forensics do?

The basic objective of nuclear forensics is to determine the origin of lost fissile materials and trace the point of diversion through interdiction for any nuclear attribution in a timely manner. Nuclear forensics also seeks to determine whether there are additional special nuclear and radiological materials endangering public safety and security available in the nuclear black market. Intercepted nuclear materials can serve as a database for materials seized in future. With the application of nuclear forensics, experts can establish whether similar fissile and radiological materials are being trafficked in the nuclear black-market. Thus, with the application of nuclear forensics, policy makers can develop essential inputs into the sources and methods of smuggled nuclear and radiological materials. These inputs when combined with effective detective work can play a crucial role in attributing and prosecuting crimes relating to illicit trade in special nuclear materials. The attribution assessment would be premised on the remnants of the nuclear attack. A nuclear explosion will leave back crucial evidence like physical, chemical, isotopic and elemental data in the debris samples that scientists can collect from or near the blast site. According to the IAEA, such signatures can provide relevant clues on the nature of the material. For instance the physical characteristics like particle size distribution of uranium oxide powder can provide data about the uranium conversion process. The traced residues of debris can indicate the use of particular types of equipment or materials. Scientists would also be able to calculate the age of the material from the debris sample based on the half life of the isotope and the ratio of the amount of the parent isotope to

the amount of the radioactive decay samples. These isotopic signatures provide a fingerprint for the type and operating conditions of a particular reactor. In addition, existing computer programmes can help estimate the pre-detonation isotopic mixture, which combined with the analysis of the post-detonation isotopic mixture, may make it possible to infer the bomb's efficiency and thus its design.[16] 'The bomb design can possibly narrow the possible origins of the weapon. It is extremely implausible that a terrorist group will be able to construct a thermonuclear (hydrogen) or boosted implosion (tritium and deuterium) bomb on its own without state assistance. If the forensic analysis suggested this sort of bomb, it would be clear either that the weapon was stolen from a state's poorly secured stockpiles or that a state directly assisted the terrorist group in assembling it. Meanwhile, a crude, gun-type uranium device with a relatively low efficiency would more likely point to terrorist construction.'[17] The United States' Nuclear Emergency Search Team (NEST) also maintains a database of known weapons designs against which these findings could be compared.[18] Forensic analysts could examine debris to 'find traces of bomb components such as the casing, the reflector, and the conventional high explosive' that would provide further clues about the construction process.[19] As such, nuclear forensics does have the potential to provide a number of clues that might help to narrow down the origin of a bomb.[20] In addition, nuclear forensics can also rule out certain possible originating sources or pathways.[21] Following any accident or catastrophe,

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16 Charles D. Ferguson, 'Can Nuclear Forensics Trace a Detonated Nuclear Weapon to Its Source?, working paper, American Political Science Association Conference, August 31, 2006, at http://citation.allacademic.com//meta/p_mla_apa_research_citation/1/5/1/5/5/pages151550/p151550-10.php (Accessed November 2, 2011).

17 Caitlin Talmadge, 'Deterring a Nuclear 9/11', *The Washington Quarterly*, (Spring 2007), 30(2), p. 26.

18 Jeffrey T. Richelson, 'Defusing Nuclear Terror', *Bulletin of the Atomic Scientists,* 58(2) March/April 2002.

19 Ferguson, 'Can Nuclear Forensics Trace a Detonated Nuclear Weapon to Its Source?', op. cit.

20 Caitlin Talmadge, 'Deterring a Nuclear 9/11', *The Washington Quarterly*, 2007, 30(2), p. 26.

21 'Nuclear *Forensics*: Role, State of the Art, Program Needs', *Advancing Science Serving Society*, at http://iis-db.stanford.edu/pubs/22126/APS_AAAS_2008.pdf *(Accessed November 30, 2012), p.13.*

misinformation about the cause or the perpetrators can sap valuable resources needed to determine the facts as quickly as possible.[22] After a nuclear explosion, nuclear forensics can help to minimise such misinformation.[23] Nuclear forensics can play a cardinal role in providing as clear a picture as possible of illicit connections between those that exist in various forms like front companies, trading networks and smuggling rackets. In February 2005, reports state that the U.S. intelligence had concluded with at least 90 per cent confidence that North Korea had exported uranium hexafluoride (UF6) to Libya[24] in gas canisters containing UF6.[25] The conclusion was based upon the ratio of U-234, a rare isotope that carries a 'fingerprint' related to specific uranium deposits.[26] Even though the United States has no uranium samples from North Korea and the canisters actually belonged to Pakistan, forensic analysts reached this conclusion on the process of elimination, and the fact that the containers contained traces of plutonium produced at the Yongbyon nuclear complex in North Korea.[27]

Nuclear forensics can play a significant role in tracing the origin of orphan materials and intercepting fissile materials. In 1992 the Institute for Transuranium Elements (ITU) received four pellets of uranium from Lithuania and sourced it back to the theft of a fuel assembly from the Ignalina power plant in 1992.[28] Between 1994 and 1995 on three different occasions the police in Prague seized highly enriched

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22 Ibid.

23 Ibid.

24 David E. Sanger and William J. Broad, 'Tests Said to Tie Deal on Uranium to North Korea', New York Times, February 2, 2005, p. 1.

25 Daniel Pinkston, 'North Korea's Nuclear Weapons Program and the Six-Party Talks', Nuclear Threat Initiative, April 1, 2006 at http://www.nti.org/analysis/articles/north-koreas-nuclear-weapons/ (Accessed January 29, 2013).

26 Ibid.

27 Glenn Kessler, 'North Korea May Have Sent Libya Nuclear Material, U.S. Tells Allies', Washington Post, February 2, 2005, p. 1.

28 M. Wallenius, K. Mayer, I. Ray, 'Nuclear forensic investigations: Two case studies', *Forensic Science International* 156 (2006) at http://radchem.nevada.edu/classes/nfss/readings/kristo/Nuclear%20Forensic%20Investigations-2%20Case%20Studies.pdf (Accessed February 21, 2011), p.58.

uranium (HEU) and Ceske Budejovice. All these stolen samples were traced back to Prague, in the Czech Republic.[29] The German authorities seized 14 uranium pellets on February 22, 2007 in a garden in Lauenförde, Germany.[30] They contacted the ITU asking for nuclear forensic support. Nuclear forensic investigations identified a 'German facility as the only possible source of the material.' The pellets had been produced for a pressurised water reactor in Germany.[31] The fact that the pellets were not ground and showed physical damage suggested that the material was rejected from the production after pellet calcination.[32] Theft of the material may then have occurred from this scrap material.[33] The key findings of this investigation were reported to the German authorities within a week of the arrival of the samples at ITU.[34] A full report was made available within two months, thus fully consistent with the reporting scheme recommended by the Nuclear Forensics International Technical Working Group (ITWG).[35]

It is important that the application of nuclear forensics is able to provide reliable information with accurate attribution capability in a timely manner. In a post-detonation scenario, the existing political establishment will face enormous pressure to attribute the source of the nuclear material in an accurate and timely manner. If the element of timeliness is not met then the information collected months after a post detonation would not only be late but also counterproductive. President George W. Bush announced war on terrorism and within nine days of the 9/11 attacks, indicated that Osama bin Laden and Al Qaida were responsible for the attacks on September 20.[36] In addition, information

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29 'List of confirmed incidents involving HEU or Pu', at http://www.iaea.org/newscenter/features/radsources/pdf/rad_matl_table1.pdf (Accessed February 21, 2011).

30 'Institute for Transuranium Elements Annual report 2007', *JRC European Commission,* at http://itu.jrc.ec.europa.eu/uploads/media/Annual_Report_2007_01.pdf (Accessed February 21, 2011), p. 52.

31 Ibid.

32 Ibid.

33 Ibid.

34 Ibid.

35 Ibid, p. 53.

36 George W. Bush, 'Transcript of President Bush's address to a Joint Session of Congress', September 20, 2001.

collected in a post detonation scenario that accurately attributes the source of the material is critical in assisting the establishment in dealing with security lapses in nuclear facilities from where the nuclear materials were stolen and in other places of origin like reactors of reprocessing facilities. However, to facilitate the same it is important that the post detonation forensics provide critical information in a shorter time to meet the aim of accurately attributing the facilities of people associated with stolen nuclear materials or device. At present, there is not much information on post detonation timeline in the public domain. However, the following table provides an outline of the steps to be undertaken and a tentative timeline in a post detonation scenario.

Table 1: Timeline for post detonation steps

Steps	**Time required**
Quarantine the site of detonation	hours to days depending on the extent of damage done
Collect the post detonation debris and other samples	minutes to hours
Transport the debris from the site of explosion to the laboratories	hours to days
Analyse the post explosion debris	days or weeks
Attribute the material to its origin	hours to days

It is noteworthy that a relevant library of database and taggants[37] can reduce time for analysing the post detonation debris and facilitate the attribution process.

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[37] Taggants offer one potentially effective means for positively identifying lost or stolen nuclear fuels. Taggants are materials that can be encoded with a unique signature and introduced into nuclear fuel during fuel fabrication. During a nuclear forensics investigation, the taggant signature can be recovered and the nuclear material identified through comparison with information stored in an appropriate database. Unlike serial numbers or barcodes, microtaggants can provide positive identification with only partial recovery, providing extreme resistance to any attempt to delete or alter them. See M. J. Kristo, M. Robel, I. D. Hutcheon, "Nuclear Forensics and Attribution for Improved Energy Security: The Use of Taggants in Nuclear Fuel," UCRL-TR-229878, April 12, 2007 at https://e-reports-ext.llnl.gov/pdf/346122.pdf *(Accessed on November 30, 2012).*

Can nuclear forensics contribute in increasing the chances of failure of carrying out a terrorist act involving fissile materials? Nuclear forensics might not directly facilitate in terminating an act of nuclear or radiological terrorism. The terrorist organisation might not be deterred by the possibility that it will be identified after a terrorist act through nuclear forensics or through the overall attribution process.[38] In fact, it might reveal its identity after the act. For a terrorist organisation that intends to unleash an act of nuclear terror and emphasise that it has achieved a technological feat, it is not revelation of identity but failure that acts as a deterrent. For such groups, nuclear forensics contributes to prevention by increasing the chances of failure. It increases the likelihood that if the material or the weapon is intercepted prior to the terrorist act, it will be traced to its original source and possibly to the group that designed the weapon.[39] That in turn will turn off the source of material supply and weapon expertise and it may also jeopardise the terrorist's organisation itself, particularly if the individuals in the supply or design chain are identified as a result of successful forensics, and captured.[40] This strategy increases the likelihood of intercepting smugglers and tracing the fissile material 'being illicitly transported'. However, hypothetically, a scenario can be drawn wherein nuclear forensics can play a crucial role in establishing the source of illegally trafficked nuclear material.

Scenario 1

A is arrested carrying four pellets of HEU. A month later, B is arrested with four other pellets of HEU. With the application of nuclear forensics, fingerprints of the seized HEU are found to be matching with the database provided by the research reactor of the missing twelve pellets of HEU. On interrogation A and B reveal that they bought the materials from C. With the help of human intelligence and detectives C is nabbed and found hiding four more pellets of HEU that match with the fingerprints of the missing pellets.

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38 'Nuclear *Forensics*: Role, State of the Art, Program Needs', *Advancing Science Serving Society*, at http://iis-db.stanford.edu/pubs/22126/APS_AAAS_2008.pdf *(Accessed on November 30, 2012), p.13.*

39 Ibid.

40 Ibid.

Nuclear forensics can also provide some long-term advantages. Criminals arrested with stolen fissile materials can themselves divulge information regarding the theft. However, it is important to remember that thefts involving fissile materials might not be committed by a single individual or maybe by even a handful of them. Many will be involved in pulling off such an act of theft and often these people might not be connected with one another. So the arrest of the criminal with the stolen fissile materials might not always trace it back to its source. The arrested person can also provide misleading or contradictory evidence. Thus, hypothetically, three smugglers are arrested carrying significant amounts of radioactive material Cobalt-60 from three different places on three different occasions in Somalia. Nuclear forensic experts after analysis preserve a fingerprint of the seized materials. They keep it as a database for similar materials that might be found later.

On interception of an intact and operable nuclear weapon, its design might possibly trace it back to its manufacturers and identify them. However, there are some basic designs. If forensics either on intercepted nuclear material or on post event debris can narrow the range of possible sources, intelligence and law enforcement efforts can focus on people associated with that kind of source.[41]

The science of nuclear forensics can play a crucial role in the case of a radioactive dispersal device. In the case of a radiological attack, the presence of radioactivity will complicate rescue and recovery efforts and will require a programme of public education if it is to be realistically assessed by the public.[42] It will also result in an expensive and time consuming clean-up programme.[43] In both these cases, forensic analysis, especially of radioactivity contaminated evidence, will play a large role.[44]

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41 'Nuclear *Forensics*: Role, State of the Art, Program Needs', *Advancing Science Serving Society*, at http://iis-db.stanford.edu/pubs/22126/APS_AAAS_2008.pdf *(Accessed on November 30, 2012), p.13.*

42 Ibid., p.10.

43 Ibid.

44 Ibid.

Nuclear Forensics and a Relevant Database

The likelihood of nuclear terrorism has a very low probability but once it happens the consequences will be enormous. In the event of a nuclear attack, there would be an urgent need to determine the origin of the nuclear explosive and the people responsible in carrying out the act. This is not only for fixing the penalty but also for gauging the chances of a follow up nuclear explosion. For this purpose, Michael May, Jay Davis and Raymond Jeanloz have called for the establishment of 'an international data bank of known nuclear explosive materials to aid in that process'.[45] An international database if efficiently combined with adequate international cooperation and transparency can diminish delays and hasten the attribution process. According to May, Davis and Jeanloz, 'In the current situation, obtaining this information could require months or longer after a detonation, yet there would be a great pressure for rapid, actionable information, including ruling out potential sources.'[46] If forensics together with intelligence can identify where the device was made, the experts that helped with the machining, assembly, etc. may be more easily identified since those operations, when carried out on uranium or plutonium or on high explosives are anything but routine.[47] A database is also useful in providing relevant information on the methods used within a fuel cycle, which can possibly help in attributing the material to its origin.

The proposal for an international database is fraught with the problem of some nations being hesitant to submit their nuclear samples to the database purely out of military and diplomatic reasons. However, the authors argue that 'assurance of a seat at the table in attribution decisions and the consequent political and military steps' should provide a 'primary motivation' for these states to cooperate.[48] The utility of a reference

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45 Michael May, Jay Davis and Raymond Jeanloz, 'Preparing for the Worst', *Nature*, 443(26), October 2006, pp.907-908.

46 Ibid.

47 'Nuclear *Forensics*: Role, State of the Art, Program Needs', *Advancing Science Serving Society*, at http://iis-db.stanford.edu/pubs/22126/APS_AAAS_2008.pdf *(Accessed on November 30, 2012), p.13.*

48 Matthew Phillips, 'Uncertain Justice for Nuclear Terror: Deterrence of Anonymous Attacks through Attribution', *Orbis*, 2007, p.432.

database has been questioned by skeptics. Charles B. Richardson, project leader for nuclear identification research at the Sandia National Laboratories, told the *New York Times* that existing libraries of data are more likely to help identify a stolen nuclear weapon than one improvised by terrorists using fissile material.[49] There is also the concern for 'spoofing' i.e. submission of false samples to the international database. However, May, Davis and Jeanloz '…believe that fakes would be open to discovery through subsequent analyses.'[50]

Nuclear forensics with high reliability can reach certain conclusions but those may not be sufficient to uniquely identify the source. The more extensive the database libraries of sample materials and associated isotopic analyses are, the more specific attribution can be.[51]

Nuclear Forensics as a Deterrence Strategy

Policy makers in the US as well as elsewhere in the world believe it is essential to research and develop programmes for a credible attribution strategy. If policy makers decide that the threat of nuclear terrorism is credible (and it is clear they have), it would be an indisputable reason for developing attribution technology to its most advanced possible extent along with the reference databases, intelligence and law enforcement capabilities to complement it, and to have it available in case an attack occurs.[52] Almost all policy makers and academicians will agree that terrorists are difficult or impossible to deter. However, able attribution technology or nuclear forensics might play a crucial role in deterring terrorists in the following ways:

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[49] William J. Broad, 'Addressing the Unthinkable, US Revives Study of Fallout', *New York Times*, March 19, 2004.

[50] Michael May, Jay Davis and Raymond Jeanloz, 'Preparing for the Worst', *Nature*, Vol 443/26, October 2006, pp.907-908.

[51] 'Nuclear *Forensics*: Role, State of the Art, Program Needs', *Advancing Science Serving Society*, at http://iis-db.stanford.edu/pubs/22126/APS_AAAS_2008.pdf *(Accessed on November 30, 2012), p.13.*

[52] Matthew Phillips, 'Uncertain Justice for Nuclear Terror: Deterrence of Anonymous Attacks through Attribution', *Orbis*, 2007, p. 436.

- Certain terrorist groups can be deterred by holding their ultimate political goals hostage in such a way that violence or cooperation with other groups will threaten these aims.[53]

- Most terrorist organisations, including Al Qaida, can be deterred from certain acts by increasing the chances of failure of their acts. As terrorism expert Brian Jenkins has noted, if success is a sign of divine intervention, then failure must be sign that God is not on the side of the terrorists. Therefore, failure must be avoided, even if the acts become less spectacular.[54]

- Catch the financiers and collaborators of terrorism and deter them. An act of nuclear terrorism would require intermediaries to pair buyers and sellers of nuclear materials and equipment. It would also require huge amount of money and expertise. These peripheral actors can be deterred by an effective nuclear forensics system by which the crime can be attributed to them.

Out of the above three plausible scenarios, nuclear attribution can be applied in the last two cases to deter terrorists. Terrorist organisations are aware that once attacked, and the country discovers the perpetrators, retaliation will follow. In the aftermath of the 9/11 attacks, the Bush administration in collaboration with the Saudi Arabia government engineered the evacuation of members of Osama bin Laden's extended family from the US. Any act of retribution against the people close to the terrorists will decrease the support for the objectives of the terrorists. There is also an emerging debate within the radical Islamic groups about the moral legitimacy of mass killing of innocent people.[55]

Deterring financiers and collaborators of terrorism is 'much more plausible'. However, to be able to successfully do this, a credible

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[53] Robert F. Trager and Dessislava P. Zagorcheva, 'Deterring Terrorism', International Security 30 (2005/2006), pp. 87123.

[54] Brian Jenkins, 'Where Are We in the War on Terror? A Current Assessment and Lessons', Seminar, Stanford University, Freeman Spogli Institute for International Studies, April 4, 2006.

[55] Lawrence Wright, 'The Rebellion Within', *The New Yorker*, June 2, 2008 at http://www.newyorker.com/reporting/2008/06/02/080602fa_fact_wright (Accessed June 3, 2008)

attribution bolstered by stringent standards of punishment would have to be established. This has to be further strengthened with human intelligence, law enforcement findings and well publicised interdiction methods to ascertain specific terrorists and their exact goals. It is also important to communicate the threat in advance to the terrorists and their collaborators. They have to be convinced that stringent actions will be taken once the attribution strategy detects them. Mere house arrest or fine as has happened in the case of AQ Khan's nuclear black-market in Pakistan cannot be the accepted standard of penalty any longer.

Credible nuclear forensics science is also useful for negative attribution. Negative attribution is important in establishing non-involvement of states. Terrorists can acquire nuclear materials from a particular country and use it in another target area. Post atomic explosion investigations will attribute the state from where the nuclear materials originated as the culpable country leading to international condemnation and punishment. This can be avoided if there is effective nuclear forensics strengthened by human intelligence. Such a strategy will augment the need for the state to improve and upgrade the safety and security of their nuclear stocks and materials. This is the idea behind the Cooperative Threat Reduction (CTR) programme, and expansion of the programme is advocated by many nongovernmental experts, who argue that the piece of the puzzle of nuclear terrorism that can be influenced most is the supply of nuclear material, and that, while the supplies are vast, they are finite and can be secured.[56] But all of these strategies assume a fairly monolithic, powerful state, an argument that Anders Corr disagrees with in his article on the need for a negligence doctrine.[57] According to Corr, 'Increasing the security for upgrading

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[56] See Mathew Bunn and Anthony Weir, Securing the Bomb 2005, Graham Allison, *Nuclear Terrorism: The Ultimate Preventable Catastrophe,* Henry Holt, New York, 2004, Charles D. Ferguson and William C. Potter, *The Four Faces of Nuclear Terrorism,* Routledge, New York 2005, Siegfried S. Hecker, 'Toward a Comprehensive Safeguards System: Keeping Fissile Materials Out of Terrorists' Hands', *Annals of the American Academy of Political Science,* 607 September, 2006, pp. 121-132 at http://ann.sagepub.com/cgi/reprint/607/1/121 (Accessed July 13, 2010).

[57] See Anders Corr, 'The Deterrence of Nuclear Terror', Nonproliferation Review 12 March 2005, pp. 127-147 and Robert L. Gallucci, 'Averting Nuclear Catastrophe: Contemplating Extreme Responses to US Vulnerability', *Harvard International Review* , 2005, pp. 83-84.

the safety and security of nuclear materials will lead to corruption since once all the fissile materials is secured in Russia or Pakistan, foreign aid will get reduced.' This will be a colossal loss for individual actors who are managing such security establishments. However, to deal with this scenario, a negligence doctrine should be in place that would attribute the negligent state accountable for poor security standards leading to the loss or theft of special nuclear and radiological materials.

It is also important to bear in mind that nuclear attribution including its forensic component will have considerable political consequences.[58] A careful scientific examination of the scientific forensic facts behind an attribution is critical to prevent a mistaken accusation of a group or nation.[59] The facts will include information from law enforcement agencies, government departments, medical sources and from state and local agencies.[60]

Problem areas

The science of nuclear forensics has great potential in serving as a useful tool of nuclear nonproliferation. 'The importance of nuclear forensics cannot be understated.'[61] However, this crucial scientific pursuit faces serious technical challenges. Nuclear forensics will always be limited by the diagnostic information inherent in the interdicted material.[62] A smart criminal can manipulate and damage important clues for nuclear forensics like fingerprints, stray samples. It will also be difficult for experts to differentiate between materials that have similar sources of production histories but are obtained from disparate sites.

Successful nuclear forensics and attribution process is premised upon a comprehensive nuclear database. At present, there is a lack of a

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58 'Nuclear *Forensics*: Role, State of the Art, Program Needs', *Advancing Science Serving Society*, at http://iis-db.stanford.edu/pubs/22126/APS_AAAS_2008.pdf *(Accessed November 30, 2012), p.13.*

59 Ibid.

60 Ibid.

61 Jon Fox, 'Dwindling Scientific Expertise', *Global Security Newswire*, October 11, 2007.

62 M.J. Kristo, D.K. Smith, S. Neimeyer, G.B. Dudder, 'Model Action Plan for Nuclear Forensics and Nuclear Attribution', *International Atomic Energy Agency*, March 5, 2006 at http://www.llnl.gov/tid/lof/documents/pdf/305453.pdf (Accessed July 3, 2010), p.8.

comprehensive database of nuclear material. In the American Physical Society and American Association for the Advancement of Science report on the state of the art nuclear forensics, one of the main recommendations was increased international cooperation and efforts to establish an international database.[63] However, in the 2010 National Academies of Science report, authored by some of the same individuals as the 2007 report, there was no mention of an international database.[64] A major difficulty in developing this capability lies in the mindset of political leaders who believe that sharing nuclear secrets would be tantamount to compromising on their military secrets. Today, most nuclear powers have a thorough accounting system of nuclear materials, and there are a finite number of sources of weapons grade material, all of which are known.[65] It is also useful to maintain a database of 'predictive signatures'. These are valuable fingerprints, which can be matched with the debris obtained by forensic experts from a nuclear explosion to attain results in the quickest possible time. These data could then be consolidated. Some effort is currently being made along these lines within the US, but there is still not a comprehensive database.[66]

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[63] Joint Working Group of the American Physical Society and the American Association for the Advancement of Science, 'Nuclear Forensics Role, State of the Art, and Program Needs', 2008 as stated in Karen Koop Hogue, 'Postdetonation Nuclear Forensics: Methods to Improve the Craft', Nuclear Scholars Initiative, CSIS, 2012 at http://csis.org/files/publication/121017_Spies_NuclearInitiative_Web.pdf pp.202-203. (Accessed February 13, 2013).

[64] Committee on Nuclear Forensics, National Research Council, Nuclear Forensics: A Capability at Risk (Washington, D.C.: National Academies Press, 2010) as stated in Karen Koop Hogue, 'Postdetonation Nuclear Forensics: Methods to Improve the Craft', Nuclear Scholars Initiative, CSIS, 2012 at http://csis.org/files/publication/121017_Spies_NuclearInitiative_Web.pdf pp.202-203. (Accessed February 13, 2013).

[65] Victor S. Rezendes, 'Concerns with the U.S. International Nuclear Materials Tracking System', Testimony Before the Committee on Governmental Affairs, U.S. Senate, No. 156311, United States General Accounting Office, February 28, 1996.

[66] Gabriele Rennie, 'Tracing the Steps in Nuclear Material Trafficking', Science & Technology Review March 2005, Bwww.llnl.gov/str/March05/Hutcheon.html, William J. Broad, 'Addressing the Unthinkable, US Revives Study of Fallout', *New York Times*, March 19, 2004, p. A 1, and William J. Broad, 'New Team Plans to Identify Nuclear Attackers', *New York Times*, February 2, 2006, p. A 17. The most thorough examination was by Jay Davis, who had made speeches on the topic and had written a detailed article for a smaller audience, 'The Attribution of WMD Events', *Journal of Homeland Security,* April 2003, Bwww.homelandsecurity.org/journal/Articles/Davis.htm.

In fact, the initial database hopes only to encompass low enriched uranium (LEU).[67] The IAEA also keeps track of samples from safeguarded reactors and monitors reactor history from these plants, but its database is far from comprehensive.[68] Many states have an idea what the material inside their weapons and reactors looks like, and many could give a sample to the IAEA or some other international body if they thought conditions were right.[69]

However, most countries would be unwilling to share information about their nuclear infrastructure. In fact, such reticence is coded into law in some states.[70] It is obvious that although having a global database is an ideal solution, it cannot be pursued since key states like the US are likely to have trouble convincing domestic constituents to give up nuclear secrets to an international monitor.[71] There might also be distrust among states regarding the secrecy of such a database.[72] The IAEA has access to isotopic information obtained from environmental swipes used at safeguarded facilities and even outside safeguarded facilities if the country ratified the Additional Protocol.[73] However, such data provided

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67 David Smith and Steven Kreek, 'Opportunities in Nuclear Forensics: An Emerging Era for Radiochemistry as a Discipline', Powerpoint presentation, Lawrence Livermore National Laboratory, March 28, 2006, <www-cms.llnl.gov/acs/docs/smith.pdf> (Accessed April 4, 2011).

68 Miller, Michael, 'Nuclear Attribution as Deterrence', *The Nonproliferation Review*, 14 (1), 2007, p. 50.

69 See S. Niemeyer, L. Koch, and N.V. Nikiforov, 'Synopsis of the International Workshop of Illicit Trafficking of Nuclear Material', Lawrence Livermore National Laboratory, UCRL-JC-126561, Russian International Conference on Nuclear Material Protection, Accounting, and Control, March 1997, p. 3,

70 Michael May, Jay Davis and Raymond Jeanloz, 'Preparing for the Worst', *Nature*, Vol 443/26, October 2006, pp. 907-908.

71 Miller, Michael, 'Nuclear Attribution as Deterrence', *The Nonproliferation Review*, 14 (1), 2007, p. 50 -51.

72 See Committee for International Security and Arms Control, Monitoring Nuclear Weapons and Nuclear-Explosive Materials: An Assessment of Methods and Capabilities (National Academies Press, Washington, DC, 2005) at www.nap.edu/catalog/11265.html (Accessed July 6, 2010).

73 IAEA, 'Factsheets & FAQs', in IAEA Safeguards Overview: Comprehensive Safeguards Agreements and Additional Protocols (Vienna: IAEA, 2011) as stated in Karen Koop Hogue, 'Postdetonation Nuclear Forensics: Methods to Improve the Craft', Nuclear Scholars Initiative, CSIS, 2012 at http://csis.org/files/publication/121017_Spies_NuclearInitiative_Web.pdf pp.202-203. (Accessed February 13, 2013).

by states are considered 'safeguards confidential' information, which is provided by member states under conditions of extreme secrecy. The IAEA is constrained from using this data to avoid infringement of agreements between the member states and the atomic agency. States also fear that sharing of sensitive information about their nuclear facilities would lead to retribution against the state if elements from within it were involved in trafficking of fissile materials. However, May and his colleagues have suggested that this can be dealt with by having a system of challenge inspections in place that can verify encoded or hashed data in the event of a post nuclear explosion.[74] This can help exclude states from suspicion in the aftermath of a post nuclear attack.

Established libraries and databases of nuclear material are crucial in fixing retribution to states that are advertently or inadvertently involved in an act of nuclear terror. An international database can act as a coercive tool in exhorting states to voluntarily provide samples of their nuclear stocks or remain vulnerable to suspicion. However, this can prove to be counterproductive. For example, Pakistan or North Korea might view such a threat as provocation. In case of materials stolen from these countries, cooperation instead of retaliation would be a more pragmatic option to deal with the situation. Moreover, a retaliatory threat might serve the intentions of terrorists who want the West to take on Islamic countries like Pakistan and Iran to create further wedge between the West and the Islamic world. International collaboration in establishing a database in order to globally upgrade nuclear security and safety might also be regarded by individual states as cutting down of foreign aid. It might be of little incentive to countries like Pakistan, which spend millions of dollars for improving the security of their nuclear infrastructure.

At present international databases are not extensive or usable enough to fulfill the potential utility of nuclear forensics in the event of a detonation.[75] In that light, an ideal international database would include:[76]

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74 Michael May, et.al., 'Preparing for the Worst', *op. cit*, pp.907-908.

75 'Nuclear *Forensics*: Role, State of the Art, Program Needs', *Advancing Science Serving Society*, at http://iis-db.stanford.edu/pubs/22126/APS_AAAS_2008.pdf *(Accessed on November 30, 2012), p.13.*

76 Ibid.

- characteristics of fissile materials
- other information about nuclear material that may be relevant to tracing fissile materials
- information on fissile material production and processing, subject to security measures to safeguard commercially protected information
- information on fissile material storage sites, including types and quantities of materials and site security measures, subject to measures for safeguarding both commercial and national security information.

Situation in India

In India, the Cabinet Committee on Security (CCS) has cleared a project of Rs 285 crores of the Ministry of Defence for developing systems and equipment for protection against nuclear, biological and chemical (NBC) weapons and leakages.[77] According to Defence Ministry officials, 'Under the project for NBC defence, Defence Research and Development Organisation (DRDO) has been tasked to develop quick and fast detection systems in case of an NBC attack on our vital installations and cities or leakage in any of the installations dealing with these materials.'[78] 'In case of any attack or leakages, such detection systems will help in finding the exact sources of contamination and the authorities concerned would be able to react in a much more effective manner,' they added.[79]

The Indian nuclear establishment is confident about its emergency preparedness. The BARC is in possession of the high tech Ariel Gamma Spectrometry System (AGSS) which is capable of swift and effective assessment by aerial surveys. The BARC has also developed the Environmental Radiation Monitoring with Navigational Aid (ERMNA) that helps in periodic mobile radiation monitoring of major cities and Emergency Planning Zones (EPZs) of nuclear power plants to generate

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[77] 'CCS nod for project for nuclear, biological, chemical defence', *The Hindu*, July 11, 2010.

[78] Ibid.

[79] Ibid.

baseline dose-rate data.[80] In addition, the Compact Aerial Radiation Monitoring System (CARMS) is in use for remote aerial monitoring in India. India also boasts of the environmental radiation monitoring systems. The Indian Environmental Radiation Monitoring Network (IERMON) is available with data transfer facilities to Emergency Response Centres.[81] There also exist 18 Emergency Response Centres located across the country equipped with latest technology to respond to a situation at a short notice.[82] Additional measures have been taken to train Border Security Forces (BSF) and police personnel to detect and intercept radiological materials on illicit transit.

The Indian government is undertaking further steps for the development of nuclear forensics within the country. Indian scientists have drafted a proposal to construct a national nuclear forensic laboratory as part of international efforts to reduce the threat of nuclear terrorism.[83] The plan calls for the nuclear forensic centre to be built in Karnataka in Southwest India no later than 2018 or 2019, and it seeks approximately $4.7 million to support the laboratory's establishment and the acquisition of internationally developed sequencing technology.[84]

Latest developments in detection of illicit nuclear materials

In 2013, the Los Alamos National Laboratory has achieved an important breakthrough in the 'test of a laser that has opened the door for using the technology as another tool against trafficking of nuclear weapons materials.'[85] The test demonstrated that neutrons could be used to 'provide officials at national transit points with evidence of an

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80 Sitakanta Mishra, 'Nuclear Forensics: Tool of Neo-Deterrence?', Geopolitics, 1 (7), November 2010, p. 24.

81 Ibid.

82 Ibid.

83 Dr Rukmani Krishnamurthy & Nisha Menon, 'Role of Nuclear Forensics in Preventing N-Terrorism', March - April 2011 at *http://www.helik.in/files/helik_1.pdf* (Accessed April 25, 2012).

84 Ibid.

85 Chris Schneidmiller, 'Lab Develops New Tool Against Nuclear Smuggling', *Global Security Newswire*, June 7, 2013 at http://www.nti.rsvp1.com/gsn/article/lab-develops-new-tool-against-nuclear-smuggling/?mgh=http%3A%2F%2Fwww.nti.org&mgf=1#sthash.2ZUhVDd8.dpuf (accessed June 7, 2013)

attempt to hide illicitly held atomic substances.' They can also 'easily penetrate metal containers which can be used to hide the presence of fissile materials.' At the Plenary Meeting of the Global Initiative to Combat Nuclear Terrorism (GICNT) in Mexico on May 24, 2013, partner nations and official observers agreed to work to strengthen global capacity to prevent, detect, and respond to nuclear terrorism. Spain, which was the coordinator of the Implementation and Assessment Group (IAG) introduced three documents produced in the IAG Working Groups for endorsement by GICNT Partner Nations. The documents included:[86]

- *Nuclear Forensics Fundamentals for Policy Makers and Decision Makers*[87]
- *Guidelines for Awareness, Training, and Exercises*[88]
- *Guidelines for Planning and Organization*[89]

Recommendations

Nuclear forensics is still a developing science. It is fraught with several limitations and not a foolproof system yet. The application at present lacks adequate number of experts skilled in both the science of nuclear forensics application. Yet, it can play a significant role in tracing the origin of the nuclear weapons. It also provides a simple process of elimination, which places states out of suspicion and focuses on possibly culpable states. Nuclear forensics thus provides the first step on a journey that could be long and tedious. In order to develop and sustain a credible nuclear forensics structure that can facilitate the attribution process, certain recommendations are suggested:

- Form an international nuclear forensics team that can streamline itself with the nuclear weapons states and nuclear capable states.

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[86] '2013 Global Initiative to Combat Nuclear Terrorism Plenary Meeting Joint Co-Chair Statement', *US State Department*, May 24, 2013 at http://www.state.gov/t/isn/rls/prsrl/2013/210575.htm (accessed May 24, 2013).

[87] It raises awareness of the importance of nuclear forensics in enhancing nuclear material security and discouraging illicit uses of nuclear and other radioactive material.

[88] It highlights best practices in integrating these aspects into a nation's nuclear detection architecture.

[89] It focuses on issues inherent to successful implementation and enhancement of nuclear detection architecture.

- Establish common protocols for collection of evidence and laboratory investigations.
- Facilitate inter-laboratory forensic exercises worldwide.
- Priority must be accorded to techniques and methods for credible nuclear forensic analysis.
- Develop an international database where states will place encoded or hashed data that can be subject to challenge inspections in the event of a nuclear attack.
- Concerted efforts by the US and Russia should be undertaken in building international cooperation for keeping track of nuclear material and technology.
- The US and IAEA must improve their databases of nuclear signatures to make it further comprehensive.
- A negligence doctrine must be formulated as a wedge against nuclear capable states in case of loss or theft of sensitive materials from their soil.
- Nuclear forensics should be further supplemented with effective human intelligence and law enforcement capabilities.
- An archive of nuclear and radiological samples should be maintained.

Human reliability is a crucial constituent of a nuclear security programme. It is a fact that much of the nuclear material is increasingly being handled and processed through automated means and other innovative technical measures. However, human beings still play the most important role in maintaining nuclear security. It is a human being who must install, maintain and repair technical systems, as well as calibrate, operate and administer their components.[90] Most importantly, human presence, judgement and decision-making capabilities are required to respond to alarms, to detect and mitigate insider threats, and to neutralise adversaries.[91]

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[90] 'Human Reliability as a Factor in Nuclear Security', *World Institute for Nuclear Security*, 2012.

[91] Ibid.

However, the significant questions still remains intangible: How far is the reliability of human behaviour verifiable? Can it be measured? If the integrity and stability of those with access to nuclear materials are not assured, even the most rigorous Material Protection, Control and Accounting (MPC&A) system is vulnerable to sabotage or circumvention.[92] It is extremely crucial to improve the human reliability effectiveness in nuclear security to enhance security and reduce risk from potential insider adversaries. In this age of grand terror, no state, particularly a state with nuclear weapons and nuclear capability can afford to be complacent and allow any potential loopholes to exist in the nuclear security programme of its own or any other country, whether it is an ally, enemy or otherwise. The need of the hour is increasingly bold and forceful action that will substantially reduce the risk.

In the final analyses, nuclear forensics and a similar attribution process can serve as a useful tool for nonproliferation. Having a credible attribution system will make nuclear weapon states, particularly the newly emerging nuclear capable nations, to be vigilant about their nuclear weapons and fissile material stockpile. The threat of nuclear terrorism is no longer science fiction but an 'ongoing reality.' Any complacency in securing these most lethal assets might compel any nation in the world to pay with the price of a nuclear detonation on their own soil. Hence, there is no other option but to prevent failure. After all, the doomsday clock is ticking.

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[92] Ibid.

V Conclusion

On the brighter side, despite the continuing risk of nuclear weapons falling into the hands of terrorists groups and a consequent act of nuclear terrorism, the situation has not spiralled out of control yet. The Lugar Survey on Proliferation Threats and Responses conducted in 2005 pitched the median estimate of the risk of a nuclear attack (by terrorists) during the next five years as 10 per cent while the average estimate was 16.4 per cent.[1] When the period was extended to 10 years, the median response doubled to 20 per cent and the average response almost doubled to 29.2 per cent.[2] In 2007, physicist Richard Garwin put the likelihood of a nuclear explosion on an American or European city by terrorist or other means at 20 per cent per year, which could work out to 87 per cent over a 10-year period.[3] So far, these prognoses still remain probabilities. Over decades, renowned terrorism expert Brian Jenkins has published his (not unreasonable) warnings about how 'the world's increasing dependence on nuclear power may provide terrorists with weapons of mass destruction.'[4] A group empowered by the Atomic Energy Commission (AEC) darkly noted that 'terrorist groups have increased their professional skills, intelligence networks, finances, and levels of armaments around the

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1 Senator Richard G. Lugar, 'The Lugar Survey on Proliferation Threats and Responses', June 2005 at *http://lugar.senate.gov/nunnlugar/pdf/NPSurvey.pdf,* pp.14-15, (Accessed n November 29, 2012).

2 Ibid.

3 John Mueller, 'The Truth About al Qaeda: Bin Laden's Files Reveal the Terrorists in Dramatic Decline', *Foreign Affairs*, August 2, 2011.

4 Brian Michael Jenkins, 'International Terrorism: A New Mode of Conflict', in David Carlton and Carolo Schaerf (eds.), *International Terrorism and World Security,* Wiley, New York, 1975, p.33, as stated in John Mueller, *Atomic Obsession: Nuclear Alarmism from Hiroshima to Al-Qaeda* Oxford University Press, New York 2010, p.162.

world.'[5] The group further elaborated that the 'acquisition of special nuclear material remain the only substantial problem facing groups which desire to have such weapons.'[6] Despite these grim warnings about an apocalyptic disaster, the positive aspect is that, so far terrorists have not been able to surmount 'the only substantial problem' (i.e. acquisition of fissile materials) facing them still. However, this is not enough. An attempt can be made to pre-empt a failure in imagining the array of difficulties in executing an act of nuclear terrorism. John Mueller catalogues a list of barriers that a potential atomic terrorist would effectively have to go through and surmount them before committing an act of nuclear terror.

The atomic terrorist's task in the most likely scenario[7]

- An inadequately secured source of adequate quantities of HEU must be found.
- The area must be entered while avoiding detection by local police and by locals wary of strangers.
- Several insiders who seem to know what they are doing must be corrupted.
- All the insiders must remain loyal throughout the long process of planning and executing the heist and there must be no consequential leaks.
- The insiders must successfully seize and transfer the HEU, which must not be a scam or part of a sting and it must not be of inadequate quality due to insider incompetence.
- The HEU must be transported across the country over unfamiliar turf while its possessors are being pursued.
- To get the HEU across one or more international borders, smugglers must be employed, and they must remain loyal despite,

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5 Micah Zenko, 'Intelligence Estimates of Nuclear Terrorism', *The ANNALS of the American Academy of Political and Social Science*, September 2006, pp. 94-95. John Mueller, *Atomic Obsession*, op.cit.,p.162.

6 Ibid.

7 John Mueller, *Atomic Obsession*, op.cit.,p.186.

potentially, the temptations of massive reward money even as no consequential suspicion is generated in other smugglers using the same routes who may be interested in the same money.

- A machine shop must be set up in an obscure area with imported, sophisticated equipment without anyone becoming suspicious
- A team of highly skilled scientists and technicians must be assembled and during production all members of the team must remain absolutely loyal to the cause and develop no misgivings or severe interpersonal or personal conflicts.
- The complete team must be transported to the machine shop, probably from several countries, without suspicion and without consequential leaks from relatives, friends and colleagues about the missing HEU].
- The team must have precise (not general sketches) technical blueprints to work from and must be able to modify these appropriately for the precise purpose at hand over months (or even years) of labour and without being able to test.
- Nothing significant must go wrong during the long process of manufacture and assembly of the improvised nuclear device.
- There must be no inadvertent leaks from the team.
- Local and international police, on high (even desperate) alert, must not be able to detect the project despite traditional policing methods as well as the most advanced technical detection equipment being used.
- No criminal gangs or other locals must sense that something out of the ordinary is going on in the machine shop with the constant coming and going of non-local people.
- The improvised nuclear device (IND) weighing a ton or more must be smuggled without detection out of the machine shop to an international border.
- The IND must be transported to the target country either by trusting the commercial process, filled with people on the alert on the cargo of this sort, or by clandestine means, which requires

trusting corrupt co-conspirators who may also know of any reward money.

- A team of completely loyal and technically accomplished co-conspirators must be assembled within, or infiltrated into, the target country.
- The IND must successfully enter the target country and must be received by the in-country co-conspirators.
- A detonation team must transport the IND to the target place and set it off without anybody noticing and interfering, and the untested and much travelled IND must not prove to be a dud.

The list portrays a lengthy set of hurdles confronting potential atomic terrorists. Terrorism experts who caution about the probability of a nuclear attack, assert that even in the face of the enormous technical and logistical obstacles confronting would-be nuclear terrorists it is 'not impossible',[8] in the words of William Langewiesche, for terrorist groups to surmount the odds stacked up against them. However, it is vital to point out that while it may not be impossible to surmount each individual step, the likelihood that a group could surmount a series of them could quickly approach impossibility.[9]

It cannot be denied that an act of atomic terrorism involves a series of daunting tasks and it is pertinent that the terrorists must succeed at every stage. Right from procuring or fabricating a nuclear bomb to transporting and then detonating it within the target country involves a series of difficulties.

There have been significant concerns about 'loose nukes', especially after the breakdown of Soviet Union. A careful assessment conducted by the Centre for Nonproliferation Studies (CNS) has concluded that these devices did not exist ever, (and hence were actually never lost) but that if they had existed, their production and maintenance would

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[8] William Langewiesche, *The Atomic Bazaar: The Rise of the Nuclear Poor*. Farrar, Straus & Giroux, New York, 2007, p.69.

[9] John Mueller, *Atomic Obsession*, op.cit., p.183.

have been very expensive.[10] Loose nukes even if they existed anywhere regardless, their effectiveness would be very low or nonexistent, because they (like all nuclear weapons) require continual maintenance.[11] In fact, after a comprehensive consideration, Jenkins came to the conclusion, '…it is probably true that there are no loose nukes, transportable nuclear weapons missing from their proper storage locations and available for purchase in some way.'[12] Many cautioned against the pilferage or illicit trade of suitcase bombs from Russia. It is noteworthy that Russia has deep interest in maintaining vigilance on nuclear weapons existing within its territory and safeguarding them from falling into the hands of non-state actors like the Chechen terrorists. Likewise the government in Pakistan is aware of it being a target of the Al Qaida and other fundamentalists and has, therefore, taken keen interest in improving the security of its nuclear assets including weapons, materials and its scientists. According to Stephen Younger, former head of nuclear weapons research and development at Los Alamos National Laboratory (LANL), '…regardless of what is reported in the news, all nuclear nations take the security of their weapons very seriously.'[13] Besides, nuclear weapons are not like a sack of grain in a godown. They are highly prized assets of any country and are kept under ultimate possible security. Hence, in the event of the loss of an intact and operable nuclear weapon, it would be detected soon and an intense search would be conducted worldwide in pursuit of it. Given the increasing pace of technological development, 'finished bombs have been outfitted with devices that will trigger a nonnuclear explosion that will destroy the bomb if it is tampered with.'[14] After an experts poll, *Washington Post* reporter Dafna Linzer pointed out, 'Experts said it would be very difficult for terrorists to figure out on their own how to work a Russian

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[10] Centre for Nonproliferation Studies, *Suitcase Nukes: A Reassessment,* Monterey Institute of International Studies, Monterey, CA, September 23, 2002 at http://cns.miis.edu/stories/020923.htm (Accessed November 30, 2012).

[11] Ibid.

[12] Brian Jenkins, *Will Terrorists Go Nuclear?* Amherst, New York 2008, pp. 149-150.

[13] Stephen M. Younger, *Engendered Species: How We Can Avoid Mass Destruction and Build a Lasting Peace?,* Ecco, New York 2007, p. 93.

[14] Brian Jenkins, *Will Terrorists Go Nuclear?*op.cit., p.141.

or Pakistani bomb. Newer Russian weapons, for example, are equipped with heat and time-sensitive locking systems, known as permissive action links, that experts say would be extremely difficult to defeat without help from insiders.'[15] As a significant technological advancement, British scientists have created a machine that can detect terrorist attempts to smuggle nuclear material through ports and airports, even if it has been shielded from giving off radiation.[16] The technology is unique because unlike existing nuclear detectors, the new Muon-based machines can thwart attempts to disguise or hide radioactive material.[17] The unique aspect about this machine is that [a terrorist] would need so much lead to stop detection that no tyre would be able to support a car or a truck carrying it.[18] This is a significant step towards preventing nuclear proliferation or a dirty bomb attack. Likewise, there exist several advanced security techniques whereby bombs can be disassembled with the component parts stored in separate high-security vaults, and things can be organised so that two people and multiple codes are required to not only use the bomb but also to store, maintain and deploy it.[19] If non-state actors seek to recruit or coerce any expert to operate the bomb, it will appear 'only very few people in the world have the knowledge to cause an unauthorised detonation of a nuclear weapon.'[20] Bomb engineers, designers and other maintenance personnel are trained to undertake only 'limited set of functions'.[21] It is only a few authorised people who are adequately informed about the multiple types of signals that are indispensable to set off a bomb.

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15 Dafna Linzer, 'Nuclear Capabilities May Elude Terrorists, Experts Say', *The Washington Post*, December 29, 2004, p. A 01.

16 Oliver Wright, 'Dirty bomb terror threat breakthrough: British scientists build machine to detect smuggling of nuclear materials', *The Independent*, November 2, 2012 at file:///C:/Documents%20and%20Settings/AKH/Desktop/Monograph%202012/New%20Data/dirty-bomb-terror-threat-breakthrough-british-scientists-build-machine-to-detect-smuggling-of-nuclear-materials-8273751.html (Accessed November 3, 2012).

17 Ibid.

18 Ibid

19 John Mueller, *Atomic Obsession*, op.cit., p.167.

20 Stephen M. Younger, *The Bomb: A New History* Ecco, New York ,2009), pp.153-154.

21 John Mueller, *Atomic Obsession*, op.cit., p.167.

Given the technological and logistical challenges involved in building a nuclear device by terrorists, the more viable option would be to steal or illicitly purchase fissile material. Though there are significant concerns over the security standards of the existing stocks of fissile material both in Pakistan as well in Russia, it can be said with fair authority that both the governments are making efforts to improve the security of nuclear assets in their respective countries. Pakistan for that matter keeps exceedingly careful watch over its bomb-grade uranium.[22] 'It is difficult to imagine that the Pakistani Government would turn a blind eye to a future AQ Khan network if it is believed that nuclear material or technology could be traced definitively back to Pakistan and that its people and infrastructure would suffer the consequences if those items were used in an attack against the US. A similar logic might caution Iran against transferring such items to Hizballah, a long-standing recipient of conventional Iranian military technology and armaments, or warn North Korea against selling parts of its emerging nuclear arsenal to the highest bidder.'[23]

However, even with the highest security standards, there are terrorist groups who are seeking nuclear weapons, materials, blue-prints and technologies. Documented evidence indicates that terrorists would still employ means to acquire the sensitive materials. They might in collusion with insiders hunt for fissile material. This would mean 'trusting bribed but not essentially dependable insiders' who might either cheat or break down (if the insiders are particularly working for the government, and blackmailed or forced into committing an act of contravention) under pressure. Given the difficulties, the insiders might try to smuggle the stolen fissile material, which would involve 'the purchasers to pay off a host of greedy confederates, including brokers and money transmitters, anyone of whom can turn on them or, either out of guile or incompetence, furnish them with stuff that is useless.'[24] Alternatively,

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[22] Gary Milhollin, 'Can Terrorists Get the Bomb?', *Commentary Magazine*, February 2002, pp. 45-49 at http://www.wisconsinproject.org/pubs/articles/2002/terror-bomb.htm (Accessed November 30, 2012).

[23] Caitlin Talmadge, 'Deterring a Nuclear 9/11', *The Washington Quarterly*, 200730 (2), p. 32.

[24] Michael Levi, *On Nuclear Terrorism*, Harvard University Press, Cambridge, MA, (2007), pp. 29, 32-33.

even if the required fissile material is successfully handed over to potential atomic terrorists by insiders, the latter still run the risk of getting recognised. With technological advancement, it is quite unlikely that the pilfered uranium would remain undetected for long. As soon as the loss is discovered, a search operation would be instantaneously ordered for it and those people would immediately come under suspicion who are in a position to compromise and assist thieves. Quite obviously that person would attract immediate attention 'who seems suddenly to have become prosperous.' The impending consequences once identified will also deter potential insiders from colluding with nuclear smugglers. Once a national hero, AQ Khan was subjected to disgrace. For years, Khan was under house arrest by the government of Pakistan for trading in atomic secrets. Hence, given the harsh end results, potential insiders can have second thoughts of colluding with terrorists even in the face of lucrative rewards and prefer reporting to the authorities for any missing sensitive nuclear material. Insiders also run the risk of being eliminated by the terrorists who after accomplishing their task of procuring the fissile material intend to 'have every incentive to cover their trail, beginning with eliminating their confederates.'[25] Even in the best of tempting circumstances to beneficial prospects or sympathetic ideology, an insider would prefer to remain a disgruntled nuclear scientist rather than being a dead disgruntled nuclear scientist.[26]

Hypothetically, if terrorists succeed in obtaining the fissile material they still would be faced by the daunting challenge of transporting the relevant fissile material across hundreds of miles out of the country over unfamiliar terrain, probably being pursued by security forces.[27] The whole operation would also put across the need for complete reliable complicity of sufficient number of co-conspirators. However, there is no possible way by which it can be guaranteed that all efforts would facilitate the successful transportation of the stolen relevant fissile material to the target destination. Besides, smugglers would also remain vulnerable to careful and suspicious criminal regulators who on

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25 Brian Jenkins, *Will Terrorists Go Nuclear?* op.cit., p.140.

26 John Mueller, *Atomic Obsession*, op.cit., p.170.

27 William Langewiesche, *The Atomic Bazaar*, op. cit., pp 48-50.

suspecting the smuggled commodity might turn the terrorists or commodity carriers to the authorities for lucrative reward money offered by cautious governments, thus disrupting the passage of the fissile material to the required destination.[28]

Once the relevant fissile material is smuggled out of the country and it reaches the required destination, terrorists would require building a well equipped machine shop to fabricate a crude bomb. Theodore Taylor had commented that building a crude nuclear device is 'simple'.[29] On the other hand physicists like Wirz and Egger have concluded in their published paper that building a crude nuclear bomb 'could hardly be accomplished by a subnational group.'[30] According to them, the task of fabricating a crude nuclear bomb is far from being easy. It is cumbersome and an extremely exacting process, which reduces it to the verge of being 'unfeasible".[31] The physicists are also joined by Bunn and Wier who recently acknowledged, '…it is not easy to make a nuclear bomb' even after 'essential ingredients are at hand.'[32] It thus appears as clearly stated in the words of Richard Garwin, '…the task of actually fabricating a nuclear explosive, once the design is fixed, is not trivial, it could be done, but not on a tight schedule and not with high confidence.'[33] Given the challenges, Michael Levi adroitly points out that even if there are only 10 barriers and even if there were a wildly favourable 80 per cent chance of overcoming each hurdle, the chance of final success, following the approach used here, would be 10 per cent.[34] With the stakes raised so high at every step, there is a probability

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28 John Mueller, *Atomic Obsession*, op.cit., pp.169-172.

29 Graham T. Allison, Owen R. Cote, Jr., Richard A. Falkenrath, and Steven E. Miller. *Avoiding Nuclear Anarchy: Containing the Threat of Loose Russian Nuclear Weapons and Fissile Material*, The MIT Press, Cambridge, Mass, 1996, p.12.

30 Christoph Wirz and Emmanuel Egger, 'Use of nuclear and radiological weapons by terrorists?' *International Review of the Red Cross*, 87(859), September 2005, pp. 499-502.

31 Ibid.

32 Matthew Bunn and Anthony Wier, 'Terrorist Nuclear Weapon Construction: How Difficult?', *The ANNALS of the American Academy of Political and Social Science*, September 2006, 607(1) p.134.

33 Richard L. Garwin and Georges Charpak, 'Megawatts and Megatons: A Turning Point in the Nuclear Age?', Knopf, New York, 2001, p. 343.

34 See Michael Levi, *On Nuclear Terrorism,* Harvard University Press, Cambridge, MA 2007.

that the terrorists might consider 'that a nuclear plot is too much of a stretch seriously to try.'[35]

Nuclear terrorism is a real and global threat. Inspite of the challenges facing an atomic terrorist, it cannot be ignored that 'terrorists (gaining) access to nuclear material is a real threat…The amount (trafficked illicitly) is small but they [terrorists] are getting more and more professional.'[36] The challenges facing a potential atomic terrorist should not be taken to mean that an act of nuclear terrorism is impossible and hence, can never happen. There is no place for that kind of complacency when we are dealing with terrorists who nurse an apocalyptic intent and seek to explode a nuclear device on targeted subjects. The probability of an act of nuclear terrorism is highly improbable. However, highly improbable events do occur. No one contemplated that a group of nineteen terrorists would successfully ram passenger jetliners into the heart of New York City and shake the entire world. In India also, it was difficult to presume that a group of 10 men would come ashore in inflatable speedboats at two locations in Colaba and hold the Mumbai city for over 60 hours. It is important to maintain a balanced approach while dealing with the threat of nuclear terrorism. It is equally essential not to become a creative alarmist and maintain restraint from becoming hysterical by contemplating the occurrence of nuclear terrorism. Similarly, no false comfort can be sought in the fact that an act of nuclear terrorism is an extremely difficult task and hence, it is impossible.

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35 Ibid.

36 'Smuggling of Atomic Materials Becoming Professionalised: Amano', *Global Security Newswire*, October 18, 2012 at http://www.nti.rsvp1.com/gsn/article/smuggling-atomic-materials-becoming-professionalised-amano/?mgh=http%3A%2F%2Fwww.nti.org&mgf=1 (Accessed November 30, 2012).

Nuclear terrorism is the most serious danger the world is facing today. Terrorist groups like Al Qaeda and Aum Shinrikyo have expressed their interest in acquiring a nuclear weapon. According to the 9/11 Commission of 2004, "Al Qaeda has tried to acquire or make nuclear weapons for at least ten years... and continues to pursue its strategic goal of obtaining a nuclear capability." The most challenging part in a nuclear terrorism act is the acquisition of fissile material. But once acquired, only 25 kg of HEU would be sufficient for terrorists could make an improvised nuclear device. There exists speculation whether terrorists will be able to construct a nuclear device if they successfully acquired the fissile material. However, considering the availability of vast literature on how to build a nuclear bomb, it can be assumed that though difficult it may not be an impossible task to develop a crude nuclear device. Besides, in my interactions with scientists in Washington, DC, I found that it is a possible task for terrorists to build a crude nuclear device if the requisite fissile material is obtained by them. The only way to prevent this is to secure nuclear materials from falling into the wrong hands.

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