Centre for Air Power Studies (CAPS)
Forum for National Security Studies (FNSS)
96/16

NUCLEAR TERRORISM AND INDIA'S EFFORTS AT ADDRESSING THE THREAT

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"Nuclear terrorism is one of the most serious threats of our time. Even one such attack could inflict mass casualties and create immense suffering and unwanted change in the world forever. This prospect should compel all of us to act to prevent such a catastrophe."

-Ban Ki-moon[1]

The threat of nuclear terrorism is not insignificant in today's times. ISIS claims to have already developed dirty bombs[2], an insider from a Belgian nuclear plant left for Syria to join a terror group[3] and smugglers are trying to trade in radioactive material[4]. A large part of terrorism is about creating fear in the minds of people. The threat of nuclear terror has done just that, with the world's major powers spending significant amounts from their budget and focussing on cooperation to counter the risk proactively. India too, has taken significant steps in securing its nuclear materials and facilities from the terrorists. This paper seeks to understand nuclear terrorism, especially in the South Asian context. It seeks to highlight the steps taken by India to overcome this threat, as well as identify some scope for improvement. The aim of the paper is not to be alarmist but rather to address the issue in a pragmatic manner.

The risk of nuclear terrorism and blackmail have amplified considerably in recent years mainly due to three factors: the growth and spread of nuclear fissile material, the expansion of civilian nuclear programs and the increase in extremist political/non-political groups waging campaigns of terror. The growing danger encompasses much of the world.[5] Inadequate security at nuclear facilities and of nuclear material in even one part of the world can lead to catastrophic consequences for the entire human race.

Nuclear Terrorism: Myth or Reality?

> *"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. Were such an attack to occur, it would not only cause widespread death and destruction, but would stagger the world economy...creating a second death toll throughout the developing world."* -Kofi Annan[6]

According to the NDMA (National Disaster Management Authority) Guidelines for Management of nuclear and radiological emergencies "even while we have an enviable and impeccable record of safety and virtually fail-safe arrangements in all our nuclear establishments, the possibility, however remote it may be, of human error, systems failure, sabotage, earthquake and terrorist attacks leading to the release of radioactive matter cannot be entirely ruled out."[7]

The actual possibility or risk of nuclear terrorism is a highly disputed topic. Critics dismiss nuclear terrorism on technical grounds, claiming that strict national controls on the use of radiological and nuclear material, even orphaned resources rule out such a possibility. This is highly premature as only technical barriers to the construction of HEU based crude nuclear bombs may not be sufficient to avoid nuclear terrorism. HEU exists in large quantities and HEU detection at border crossings and check points, is difficult due to the low levels of radiation that are emitted.[8] Also this approach completely ignores the possibility of a sabotage, radioactive contamination of water streams or a cyber-attack.

The risk of an event can be calculated as a product of the probability that it will occur and the possible consequences in case it occurs. If the low probability of nuclear terrorism is multiplied by the astronomical consequence of a successful act, the risk of nuclear terrorism must be considered to be high and growing. The probability of such an event in turn depends upon the group's intention to perform such actions as well as their capability to actually do so. We have already established the fact that the consequences of such an attack would be cataclysmic and with the growing technological capabilities of terrorists and radicalisation of intentions to harm the society, the risk is not inconsequential. ISIS is quickly proving to be one of the most violent and 'efficient' terror groups of all times. 5 years back nobody could have imagined that a terrorist organisation would occupy territory in Iraq and Syria and indulge in black market trading of oil. Yet that is today's reality.

According to the IAEA's Illicit Trafficking Database, as of 31st December 2015, a total of 2889 confirmed illicit trafficking incidents were reported between 1993 and 2015 by the 131 participating states. The database covers all types of materials i.e. uranium, plutonium, thorium, all naturally occurring and artificially created radioisotopes and radioactively contaminated material. There were 454 reported incidents involving unauthorized possession and related criminal activities, 762 incidents involving reported theft or loss and 1622 incidents involving other unauthorized activities and events. In the remaining 71 cases, the reported information was not sufficient to determine the category of incident. Incidents of thefts and losses are indicative of vulnerabilities in the security and control systems at the originating facility and indicate a continuing nuclear security concern. The majority of thefts and losses reported to the ITDB involve radioactive sources that are used in industrial or medical applications. There also appears to be a persistent problem for some countries in securing and detecting the unauthorized disposal of radioactive sources. [9]

The fact sheet also shows there has been an increase in the annual incidents of theft and loss since the late 1990s. And because the IAEA fact sheet is based on voluntary reporting by governments, who are reluctant to embarrass themselves or disclose sensitive information, it may well be that the report represents just the tip of the iceberg.[10]

What Is Nuclear Terrorism?

Nuclear terrorism is defined as 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.[11] The definition of nuclear terrorism is evolving in tandem with the evolution of threats with technological advancements expanding the possibility of cyber-attacks, nuclear theft, insider threat and most importantly the increasing role of non-state actors.

Nuclear terrorism has been defined as an offense committed if a person unlawfully and intentionally "uses in any way radioactive material with the intent to cause death or serious bodily injury; or with the intent to cause substantial damage to property or to the environment; or with the intent to compel a natural or legal person, an international organization or a State to do or refrain from doing an act."

There is no consensus on the definition of nuclear terrorism. This paper defines nuclear terrorism as acts of violence and destruction performed by non-state actors not only including the use of nuclear

explosive devices but also the sabotage of nuclear plants, radiological contamination or cyber-attacks- or threats of such actions- with the resolve of causing destruction to property and environment, causing bodily harm, creating a condition of fear, getting attention, blackmailing and installing instability.

Nuclear terrorism could take a wide variety of forms: The terrorists could steal, buy or otherwise acquire fissile material and fabricate a crude nuclear bomb or even take over a nuclear-armed submarine, plane or base, or even a missile. They could attack a nuclear reactor or waste fuel cooling pond as well as cyber-attacks on the nuclear infrastructure. Another possibility is the disruption of critical inputs for the safe running of a nuclear reactor e.g. water supply for cooling, electrical power supply systems, causing an accident leading to leak of radioactivity. They could also attack or steal nuclear fuel or waste containers, when in transit. Polluting water streams with stolen radioactive material is also another aspect we must look at. And lastly, they could make and detonate a radiological weapon, or 'dirty bomb', to spread radioactive material.[12]

What separates nuclear terrorism from any other form of terrorism is the fact that even a single partially successful attack or even the threat of an attack can affect the entire sociological, political and economic equilibrium of the international community. Aftermath of such an attack will most likely include, the fear of a follow on attack and paranoid responses such as shutdown of freight commerce/border closures and ports, fear of radioactive isotopes associated with an increase in various cancers, bring manufacturing to a standstill, cause immense psychological blow to the people and empty the nation's coffers as a result of reconstruction and retaliation. Even a temporary stagnation of economic activities would shock the national and international financial markets.[13]

There is little that can be done to reverse the effects of such an attack, therefore, prevention is of utmost importance. The threat in itself is deadly, for the main aim of terrorism is creating fear amongst the masses and the nuclear breed of terrorism has definitely succeeded in justifying its eminent threat. Recognising this threat, nowadays most nation states are focused on participating proactively in international conventions and taking pre-emptive measures to tackle the problem head on.

The Nuclear Terrorist

Nuclear terrorism is a facet of terrorism and shares motivations similar to other types of terrorism. While it is a great tool for blackmail to achieve political goals, potential nuclear terrorists are likely to

be suicide terrorists willing to further their cause at any cost. This is largely because any person carrying out such a cataclysmic attack is likely to be aware of the fact that they might come face to face with death, while carrying out the attack or as a result of the clampdown that will follow. Terror groups have made it clear they see no moral constraint in using such weapons against the 'infidel' states in general.[14] As a shadowy, non-state entity, a terror group would not have to worry about massive retaliation, since they have little to lose in terms of terrorist infrastructure, military might or population to retaliate against. This is in contrast to a state which cannot afford such an act as it would be ostracised by the international community and face severe sanctions. [15]

Misguided religious motivations, revenge for a perceived grievance and the shock and awe of the event's massive impact could have an imperative role to play in rousing terrorists to opt for the nuclear path. For a terror group this would mean two things. Firstly, they would succeed in advancing their "divine goal", and secondly, such an act would terrorise people for generations to come.

Power projection may also be one of the major driving forces. Inducing fear in the minds of an increasing number of people has a direct relationship with the group's global impact. Such an attack would be different from a conventional attack which while perfectly capable of causing immense physical and psychological upheaval, has somewhat lost its shock factor, especially after 9/11. For conventional attacks rather than the techniques used it is the body count that creates shock and horror, which in turn requires a lot of coordination usually using more than one explosive to carry out a successful attack. A radiological attack such as using the dirty bomb on the other hand would lead to mass frenzy even with less casualties. It would raise the "stature" of the terrorist group as the most feared entity, and would vindicate delusion of contributing to the divine cause.

It is now coming to be seen that the threat of nuclear terrorism and blackmail must be assumed to be real. While the probability of this brand of terrorism in comparison to others is low, the consequences would be so grave that extraordinary vigilance and precautions should be exercised wherever nuclear weapons, materials or facilities are found.[16]

Rise of ISIS

The recent rise of the IS, out of the ashes of al Qaeda in Iraq, is also something that must be looked at in the context of nuclear terrorism. ISIS with its claims of establishing a new world order and possessing a dirty bomb is a serious threat. Whether or not they do indeed possess a dirty bomb as of now is secondary to the fact that it is on their agenda. The case of Ilyass Boughalab who in 2012 left

his job working in the vital areas of a Belgian nuclear power plant to fight for terrorists in Syria, highlights the fact that the risk of IS inspiring individuals working at sensitive facilities is not hypothetical. In November 2015, Belgian police discovered that some IS operatives involved in the Paris attacks had taken hours of surveillance video at the home of a senior official of SKN-CEN, a Belgian nuclear research centre with a substantial amount of HEU on-site.[17]

Reducing the risk of nuclear terrorism is not just about preventing theft. Countries and international organizations must also stop nuclear and radiological smuggling, strengthen emergency responses, eliminate terrorist groups pursuing nuclear and radiological weapons, prevent and deter state-sponsored terrorism, and more.

Nuclear Terrorism Scenarios

Now that we have established the fact that nuclear terrorism is a possibility we will look at some of the scenarios in which such an attack might be carried out.

Crude Nuclear Bomb

Out of all the possibilities of nuclear terrorism, creating a nuclear bomb, even if a crude one, by far is the most difficult and unlikely scenario. It would require very high levels of expertise and equipment, besides ensuring that during the entire process of assembling the bomb no one raises an alarm or becomes suspicious of their actions. It would require high levels of secrecy and efficiency. Terrorists groups as of now are not known to possess either the material or the capability to do so. The only possible way of blocking this completely would be to secure all plutonium and uranium sources of the world, which at present seems like a herculean task.[18] Making a crude nuclear bomb would not be easy, but could potentially be within the capabilities of a technically sophisticated terrorist group, as some government studies have confirmed.[19]

A so called “crude” nuclear bomb consists of two types: the gun type and the implosion type. For gun type only uranium can be used while for the latter both plutonium as well as uranium can be used. While the first one would technically be easier to construct, the discontinuation of HEU production in most parts of the world might propel terrorists to opt for the second option.

Nuclear Sabotage

In Belgium in August 2014, an insider at the Doel-4 nuclear power reactor in Belgium opened a locked valve, allowing all the lubricant for the plant’s turbine to drain out, and rigged the valve so that it

appeared to still be closed, as it should be. The turbine overheated and destroyed itself. Luckily this happened in the non-nuclear part of the plant, but this clearly shows the vulnerability.

Nuclear power stations and research reactors are vulnerable to acts of sabotage and blatant terrorist attacks that could cause the release of hazardous amounts of radioactive materials.[20] According to Anadi Kumar Sinha, Chief Engineer (Maintenance) and Scientific Officer, Nuclear Power Corporation Of India Ltd, "The biggest threat that we face right now is of nuclear sabotage. More so, because clusters of nuclear reactors are usually located next to each other. Breach in even one would be enough to set off a disastrous chain reaction. It's necessary that steps are taken to make nuclear power plants more secure." India currently has 21 operational nuclear reactors 8 of which are in Kota, Rajasthan. There is a need to come up with solutions to ensure greater safety in power plants which would be discussed later.

Inadequate security at nuclear facilities also could provide extremists within a nation an opportunity to create a situation of national terror by seizing or sabotaging a civilian nuclear power plant or a research reactor or a laboratory.

Dirty Bomb

A dirty bomb intends to cause damage by spreading harmful radioactive material that can contaminate the environment and poison the human body. It combines the radioactive material with explosives to disperse it. What a dirty bomb lacks in casualties it makes up for in terms of mass psychological and economic impact. One likely scenario would be combining substantial amount (about 9 grams) misappropriated cobalt 60 (irrespective of difficulties of acquiring it from civil sources) dispersed by 5 pounds of TNT. While the physical impact would be less than that of a conventional bomb, psychologically it would be disastrous, especially for a densely populated city like Delhi. Further contamination would depend upon wind speed and direction. It would result in chaos with roads being choked and mass hysteria. The economy would be hit and the integrity of the state would suffer.[21]

The most likely form of nuclear terrorism may involve, without mass killing or destruction, a credible threat or hoax to trigger a nuclear device or to sabotage a reactor or disperse radioactive material for highly coercive results. Such a threat or hoax is likely to cause severe social, psychological and political disruption in society.[22]

Radioactive Contamination

In 2010, Delhi experienced a radioactive scare as exposure to a metal pipe containing the radioactive Cobalt-60 found in West Delhi's Mayapuri scrap market was traced to Delhi University's Chemistry Department. National Disaster Response Force (NDRF), the Atomic Minerals Directorate for Exploration and Research (AMD), and the Bhabha Atomic Research Centre (BARC) reached the site to contain the situation. Eight people were hospitalised as a result of radiation exposure, where one later died.[23] After the incident Atomic Energy Regulatory Board (AERB) realised the need to enhance the physical security of exposure devices at every radiography work site and understand better material accounting.

Albeit farfetched, the possibility of radioactive contamination or even the threat of the same can be used to terrorise people. Placement of a small amount of HEU in a crowded market place would cause radiation without being detected as radiation detectors are used most in airports and other high security areas.

Currently, in the absence of permanent underground storage, thousands of tons of spent fuel rods are stored at sites around the world and are kept cool by water. While nations have nuclear security measures in place, risks do exist.

Cyber Security Risks

Three main forms of cyber-attack are chiefly noteworthy for nuclear security. First, a cyber-attack might be used to sabotage a nuclear facility. Second, a cyber-attack might contribute to a physical theft or sabotage attempt—for example, by confusing or disabling alarm and assessment systems. Third, adversaries might use cyber weaknesses to get access to sensitive nuclear information. [24]

While the first scenario would involve hacking the entire system, which seems highly unlikely, the last scenario is plausible and can be used as a great blackmailing tactic. Once terrorists manage the security breach, they can claim to have accessed files far more important than what they actually have in reality, creating widespread paranoia.

Worldwide trends show the increasing risk of cyber attack in nuclear facilities. These include the fact that these facilities are in the process of replacing their analogue technology with cyber intrusion prone digital systems, nuclear security technology itself is increasingly digital, from alarm systems to access control and lastly, while many systems at nuclear sites are “air-gapped” and not connected to

the broader Internet, it is quite common for this air-gapping to be compromised by connecting laptops or other systems to them as part of equipment and software maintenance and testing.[25] Nuclear security policies must focus on unceasing upgradation in the face of an ever-evolving threat, changing technologies, and newly discovered vulnerabilities.

Bugs can also be manually installed into the nuclear power system. Even a small-scale cyber security incident at a nuclear facility would be likely to have a lopsided effect on public opinion and the future of the civil nuclear industry. In 2009, a malicious computer program called 'Stuxnet' was manually uploaded into a nuclear plant in Iran. The worm took control of 1,000 machines involved with producing nuclear materials, and instructed them to self-destruct.

South Asia and Nuclear Terrorism

In South Asia, the potential for nuclear terrorism should be a matter of special concern for several reasons. These include the rapidly expanding nuclear programs in India and Pakistan involving massive investments in civilian nuclear power plants and the growing stockpiles of nuclear fissionable materials. Even more significantly, high levels of terrorist activities as well as smuggling, including instability in Pakistan pose major political challenges.[26]

Pakistan: Tactical Nuclear Weapons and Risk of Nuclear Terror

The fear that a nuclear-armed state might transfer weapons to terrorists is part of the foundation of U.S. non-proliferation policy. Though such a situation is extremely unlikely considering the fact that the terrorist group would not be able to remain anonymous after such an attack and linking it to the state sponsor would not be difficult[27], yet, the possibility of theft is something that must be looked at.

Pakistan is shifting towards sub kiloton tactical nuclear weapons intended to be dispersed to front-line forces early in a crisis, increasing the risks of nuclear theft during a crisis. [28] Despite PALs (permissive action links) in place, the tactical nukes are much more liable to be seized by terrorists, particularly in a country infested by such organisations that are anti-Pak establishments too.

Lashkar-e-toiba (LeT) which operates mainly from Pakistan generally recruits terrorists with more technical education increasing the likelihood of recruiting young nuclear technicians and scientists.[29] To Pakistan's credit despite political instability, it has managed to build a modest but rapidly growing nuclear stockpile, with substantial security measures to protect against some of the world's most

capable terrorist groups, in an environment of widespread corruption and extremist sympathies. The risk of nuclear theft in Pakistan cannot be easily dismissed.

India's Nuclear Security Challenges

India has a widespread nuclear infrastructure given its expertise in the entire fuel cycle. Theoretically, risks of nuclear security exist at each stage of the fuel cycle. But India has been alert to these. There have been stray incidents such as the one reported in 2001, when smuggled uranium was confiscated from suspected terrorists in Balurghat, West Bengal. It had been removed from the Jaduguda uranium mines in Jharkhand, and was planned to be smuggled across the Bangladeshi border. While the authenticity of such a report can be questioned, the possibility is hardly surprising given location between two well established drug trafficking routes- the golden crescent and the golden triangle.[30]

India faces both domestic terrorist threats and threats from attacks by terrorist organizations based in Pakistan. For example, on January 2, 2016, heavily armed members of the Jaish-e-Mohammed terrorist group attacked the Pathankot Air Force base in northern India, killing seven security guards.

Insider threats can also impact nuclear security. Of course Personnel Reliability Programmes are in place but the dangers can never be dismissed. In fact, it is necessary that no complacency is allowed on this front, especially as India expands its nuclear power programme.

India's Efforts at Addressing the Threat of Nuclear Terrorism

Given India's geo-political location as well as its role as a responsible nuclear power, India plays a very crucial role in combatting the threat of nuclear terrorism not only in South Asia, but the world. The Emergency Response System of DAE (Department of Atomic Energy), handles radiation emergencies and oversees their safe operations.

Domestic Measures and Initiatives to Counter Nuclear Terrorism:

Some of the measures taken by India at the national level to combat the threat of nuclear terrorism are listed as follows:

Setting up of an Inter-ministerial Counter Nuclear Smuggling Team

India has set up at the national level an institutional mechanism called a Counter Nuclear Smuggling Team to devise a coordinated multi-agency approach to deal with the threat of individuals or group of individuals acquiring nuclear or radioactive material for malicious purposes. The team has

representation from concerned Ministries/ Departments/ Agencies and meets frequently.[31] With the existence of many human and drug trafficking rings in the area, one has to be extra cautious, for those lines can be exploited to smuggle nuclear material, given they manage to get their hands on the fissile material.

SCOMET List

India has had stringent export controls since its inception as a nation. India's national export control list is also known as the SCOMET list, was first notified in the year 1995 and since then has been amended several times. Latest change in the SCOMET list have been brought to align it fully with export control list specified under MTCR and NSG.

SCOMET (Special Chemicals, Organisms, Materials, Equipment and Technologies) items are substances that are capable of dual use — industrial and military. The risk that these items may fall into the hands of terrorists, non-state actors or even states that are considered irresponsible have to be evaluated before granting licences to export the items. End-use of the SCOMET items, credentials and credibility of end-users, declaration of end-use, integrity of chain of transmission of the items from supplier to end-user, export control measures instituted by the recipient state and its capabilities and objectives of programmes relating to weapons and their delivery are some of the factors considered by an inter-ministerial working group before grant of licence to export these items.[32]

Weapons of Mass Destruction Act 2005

The Indian Atomic Energy Act, 1962, the Weapons of Mass Destruction and their Delivery Systems Act, 2000, the Unlawful Activities (Prevention) Act, 1967 as amended in 2012 and the National Investigation Agency (NIA) Act, 2008, all conform to international laws in curbing nuclear terrorism.

The WMD (Weapons of Mass Destruction and Their Delivery Systems (Prohibition of Unlawful Activities) Act 2005, criminalises the manufacturing, possession, transport/transfer of nuclear explosive devices and their means of delivery by non-state actors. The WMD, 2005 Act prohibits unlawful activities, in relation to weapons of mass destruction and their delivery systems, it is determined to safeguard its national security as a Nuclear Weapon State, it highlights India's commitment not to transfer nuclear weapons or other nuclear explosive devices, or to transfer control over such weapons or explosive devices, and not in any way to assist, encourage, or induce any other country to manufacture nuclear weapons or other nuclear explosive devices; it shows India's

commitment to prevent a non-State actor and a terrorist from acquiring weapons of mass destruction and their delivery systems and the objective of global nuclear disarmament.[33]

Global Centre for Nuclear Energy Partnership

Government of India approved the establishment of Global Centre for Nuclear Energy Partnership (GCNEP) in September 2010. Its objectives include conducting research design and development of nuclear systems that are intrinsically safe, secure, proliferation resistant and sustainable, organizing training, seminars, lectures and workshops on topical issues by Indian and International experts, promoting global nuclear energy partnership through collaborative research and training programs.[34]

In order to carry out these objectives, the centre shall host five schools specializing in certain areas:

• *School of Advanced Nuclear Energy System Studies (SANESS)* which aims to pursue design studies and analysis of advanced nuclear energy systems with features to enhance intrinsic safety, security, proliferation resistance and sustainability.

• *School of Nuclear Security Studies(SNSS)* which aims to impart training to security agencies on application of physical protection system and response procedure, to enhance physical security of nuclear facilities by developing and deploying most modern technological tools including information security and to provide facilities for test and evaluation of sensors and systems used for physical security.

• *School on Radiation Safety Studies(SRSS)* which aims to carry out research in the field of radiological safety, radiation dosimetry, environmental radiation protection, impact of nuclear and radiological emergencies, radiological impact assessment studies, to impart training and certification of personnel including First Responders in radiation protection and to maintain and update radiation protection standards.

• *School of Nuclear Material Characterization Studies(SNMCS)* which aims to promote research and development in nuclear material characterization with regards to nuclear material accounting and control, education and training in effective implementation of safeguards and nuclear forensics.

• *School for Application of Radioisotopes and Radiation Technology (SARRT)* which aims to provide state of the art research, development, demonstration and training facilities in the application of radio-isotopes and radiation technologies in areas of health care, agriculture and food.

Bangladesh and Sri Lanka, with whom India has signed nuclear cooperation agreements are the first countries where India is using the facilities and skills of GCNEP to train its personnel and guide them through nuclear programmes on proliferation, safety and security fronts.

23 Emergency Response Centres of Department of Atomic Energy

A total of 23 response centres of Department of Atomic Energy (DAE-ERCs) have already been set up and are operational at various locations of currently established DAE-ERCs include Kolkata, Delhi, Tarapur, Shillong amongst others. [35]

The DAE-ERCs are not only equipped with trained Emergency Response Teams (ERTs) and radiation detection instruments and systems for response to nuclear/radiological emergencies in public domain but they will also be able to provide technical support to respond to nuclear and radiological emergencies anywhere in the country including challenges from orphan radioactive sources and malicious acts using radioactive materials.[36]

Nuclear Forensics in India

Nuclear forensics is the technical means by which nuclear and other radioactive materials are characterized according to their composition, physical condition, age, prevalence, history, and interpreted as to the provenance, industrial history, and implications for nuclear device design, etc.

Nuclear forensics techniques are practiced in different contexts in India, such as analysis of nuclear fuel samples from reactor cores and radio analytic support for India's courts. There is a forensics laboratory in Bhabha Atomic Research Centre (BARC) that assists police in investigations of crimes (gunshot residues, lead poisoning, cyanide poisoning, and arsenic poisoning). There are strong scientific capabilities in nuclear forensic science but our ability to interpret these data is still in a state of development.[37]

Nuclear reactors are the strongest source of antineutrinos on Earth. An antineutrino detector would reveal if plutonium was removed or more uranium was added, even if the monitoring was interrupted for a period and then restarted. Compared to the radiation detectors that the IAEA uses to monitor reactors today, antineutrino detectors offer a safe, fool proof, compact, non-intrusive, and potentially low-cost alternative. Use of antineutrinos to detect fissile material can be one of the biggest breakthroughs in future which is good news for India as our India-based Neutrino Observatory (INO) research project is already under construction near Theni, Tamil Nadu.[38]

Personnel Reliability Programmes In India

Personnel reliability programmes (PRPs) are an integral part of the nuclear security set up where disloyalty or exploitation by workers can have ominous consequences. The training, reliability and integrity of the individuals who operate is of utmost importance. The various lines of enquiry which include back ground verification, criminal history, character certification, medical and psychological screening of the candidates in the Indian PRP allow for people to develop a comprehensive idea of the person. Additional care and checks while divulging sensitive information and periodic reviews of job performance as well as records of alcohol/drug abuse are used to kept the individual in check. The AERB has developed a formal code of professional ethical values for employees to adhere to and the Nuclear Power Corporation of India Limited has mandated a "Code of Ethics and Conduct".[39]

India's Participation in Measures and Initiatives to Counter Nuclear Terrorism:

India has also taken significant steps at the international level to thwart the threat of nuclear terrorism. Some of these are listed as follows:

The Global Initiative to Combat Nuclear Terrorism

This highlights the states' commitment to prevent nuclear terrorism at any cost. The GICNT is an international partnership intended to improve international capacity for prevention, detection and response to nuclear terrorism, particularly the acquisition, transportation or utilization of nuclear and radiological materials. It was created during the G8 Summit in St. Petersburg, Russia on 15 July 2006.[40] India is a party to the Global Initiative to Combat Nuclear Terrorism (GICNT) and participates in all three working groups of the GICNT in the areas of Nuclear detection, Nuclear Forensics, and Response and Mitigation. India will be hosting a meeting of Global Initiative to Combat Nuclear Terrorism (GICNT) in 2017.[41]

Convention on the Physical Protection of Nuclear Material and 2005 Amendment

The Convention applies to nuclear material used for peaceful purposes while in international nuclear transport. The Convention does not apply to nuclear materials used for military purposes or to those used for peaceful purposes but not in international transport. Increasing security concerns of large-scale terrorism, prompted by the September 11th attacks, led to the initiation of an amendment process that sought to expand the Convention's scope to cover, *inter alia*, the physical protection of nuclear material in domestic use, storage, and transport, and the protection of nuclear materials and

facilities against sabotage. The amendment process also sought to facilitate cooperation among States and the IAEA to locate and recover stolen nuclear material. It was opened for signature in 1980 and in 2007 India officially accepted the 2005 amendment.[42] The Convention also promotes international cooperation in the exchange of physical protection information. This convention allows India to enjoy significant autonomy and secrecy whilst dealing with nuclear material and weapons for military purposes and at the same time creates a platform for international collaboration to protect civil nuclear material. However, states such as Pakistan which have declared an exemption to article 17.2 of the convention are not liable to the International Court of Justice in the matters of unresolved disputes.

Nuclear Security Summit and India

India has participated in all four editions of the Nuclear Security Summit. At the fourth and final edition of the Summit in Washington, PM Narendra Modi unveiled a paradigm shift in the country's nuclear programme. The new policy reflects a "strong security culture", while also being "more open" and "less defensive". Some of the steps taken by India on nuclear security, include updating export controls for companies manufacturing nuclear technology, taking strides towards implementing nuclear safeguards, setting up an inter-ministerial counter-smuggling team, using low-enriched uranium instead of high-enriched uranium (HEU) and shutting down the only reactor using HEU.[43]

At the Fourth Nuclear Security Summit in Washington, India decided to join the three “gift baskets” in priority areas like counter nuclear smuggling, the sharing of best practices through centres of excellence such as GCNEP (Global Centre for Nuclear Energy Partnership), and finally NSS follow-up through contact group in Vienna.[44] Gift basket diplomacy involves an approach to a crucial issue where, if consensus is not reached till the lowest common denominator, then those willing can join in.

International Atomic Energy Agency (IAEA) and India

India is a participant in the IAEA’s Incident & Trafficking Database (ITDB) and has voluntarily adopted the provisions of the IAEA Code of Conduct on the Safety and Security of Radioactive Sources. IAEA has carried out review of Indian Pressurised Heavy Water Reactors under the "Operational Safety Review Teams” (OSART) mission.

Additionally IAEA has conducted the "Integrated Regulatory Review Service” (IRRS) review of India's regulatory agency, the AERB. India will propose a workshop on IAEA’s International Physical Protection Advisory Service (IPPAS) with the Agency experts during this year (2016).

India participated at the Ministerial level in the International Conference on Nuclear Security organized by the IAEA in 2013 and plans to participate at the appropriate level in 2016 as well. India contributed $ 1 million to IAEA's Nuclear Security Fund in 2013 and proposes to contribute a similar amount in 2016 as well. In addition, India made a voluntary contribution of US$ 100,000 in 2015 for the modernization of IAEA's nuclear applications laboratories in Seibersdorf, Austria.[45]

India's Contribution to Other Countries in Nuclear Security Efforts

India is viewed as a neutral power, particularly in Africa, the Middle East, South America and Southeast Asia. India has been one of the most vocal advocates for global disarmament.

India has a lot to offer from its indigenous nuclear experience, as it developed largely in isolation due to the sanctions issued by US. India has a great track record of indigenous nuclear security, nuclear forensics and power generation. Sharing this technology will contribute to maintaining a safe nuclear environment in South Asia.

India has, in principle, agreed to look into Ghana's request for cooperation in civil nuclear energy field and has also got assurance from Namibia that it will work towards ironing out issues blocking the implementation for supply of uranium for peaceful nuclear energy use. India and Kazakhstan have signed an inter-governmental agreement for Cooperation in Peaceful Uses of Atomic Energy for mutual benefit. In 2016, India concluded a nuclear agreement with Bangladesh.

Observations Regarding India's Nuclear Security and Some Suggestions:

India is conscious of the threat it faces on account of nuclear terrorism. Its steps at home and its participation in international instruments is evidence of this. However, it may be useful to look further into the following aspects.

1) The CISF (Central Industrial Security Force) which guards India's nuclear facilities is over worked and there will always be scope for improvement in Personnel Reliability Programmes.

In 2011, CISF leaders complained of 45% cuts in training equipment and low morale. This can lead to officers going rogue or simply being negligent. In 2014, a CISF head constable killed his immediate senior and two other members of the force after he opened fire with his service rifle at the Madras Atomic Power Station at Kalpakkam, showing a lapse in the PRP.[46]

Suggestion: We can establish a specialised nuclear guard force, who would be highly trained and would only protect nuclear materials and facilities. Alternatively, we can recruit more people in the force so that their burden can be reduced. In India in case of temporary labour don't go through stringent verification, which needs to change.[47] Maintenance of documents of old and new contractors, of anyone who at any point in time had access to sensitive information and more stringent measures to check possible lapses in judgement.

2) Better training and readiness of first responders i.e. local police, medical staff, hospitals etc. in dealing with radiation/ emergency situations.

Suggestion: Training of local police officers, hospitals and fire units and mock drills to deal with such a situation. Making protective gear and equipment available to first responders for radiation detection at all times. The government must add such courses in the syllabus of medical universities throughout the country. Special trauma hospitals need to be developed as well.

Conclusion:

There are many ways of looking at the threat of nuclear terrorism. Some believe the threat is not only real but something that will inevitably happen in the near future. There are also people who while emphasizing the importance of proactive measures believe that if the necessary steps are taken in time, such a devastating scenario can be wholly avoided. Then there are others who wholly dismiss the very idea of nuclear terrorism.

The first approach while unnecessarily alarmist urges the state to take measures to lessen the blow. The second approach, is pragmatic and focuses on removing the existing systematic loopholes to secure a safer future. The last approach is one we should steer clear from. Complacency, especially regarding something that can have mammoth consequences is not something we can afford. Just because something hasn't happened yet, doesn't mean it never will.

President Barack Obama has claimed that nuclear terrorism is the single biggest threat we face today. India recognizes the threat that nuclear terrorism poses and has taken stringent national as well as international steps to curb such a possibility. Despite such proactive behaviour there are some problems which still persist in the international system. The growing trend of radicalised terror groups, technology and missing fissile material just reiterate the fact that our work here is far from over. We cannot depend on the inefficiency of the terrorists for our own safety. The stakes are too high.

(Disclaimer: The views and opinions expressed in this article are those of the author and do not necessarily reflect the position of the Centre for Air Power Studies [CAPS])

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