Nuclear Renaissance, Human Security and Political Risk

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The so-called nuclear renaissance, driven by a widening gap between demand for energy and available sources, is producing a large number of new nuclear power plants (NPPs). As per estimates by the World Nuclear Association, more than 90 power reactors with a total generating capacity of some 100,000 MWe are currently planned and over 200 more have been proposed.[1] Much of the expansion will be in Asia. The discussion and debate over the prospects for nuclear energy has tended to revolve around cost issues and over the new acceptability of nuclear power as a "clean" source of energy that can act as a restraint on global warming.[2] It is equally important to factor in the numerous risks associated with the rapid expansion of nuclear energy. These include safety issues as well as security issues.[3]

This paper focuses on the latter and more narrowly on the importance of securing NPPs from terrorist attacks. Such attacks, if successful, could have severe adverse effects on human security in diverse ways. These include physical damage to life and health, the psychological costs to the human mind, the economic costs and their impact on livelihoods, and the political costs in terms of instability and violence that would feed into the above. This paper outlines the nature of the threat, the potential human security costs, and the measures that can be undertaken to lower the risks. In doing so, it calls for decisions on initiating or expanding nuclear power production to be made while keeping in mind the need to minimise the harm to human security.

How Serious Is the Threat?

There is a tendency to discount the risk of terrorist attacks on NPPs on the ground that it has never happened; that most terrorists are not prone to indiscriminate mass destruction; and that, precisely because of the risk, power plants are invariably highly secure establishments. Thus, John Mueller argues that there is a tendency to exaggerate the threat: "what we get is mostly fear-mongering" and that "ultimately, the enemy is us."[4] Similarly, Brian Jenkins asserts that "it's about our imagination. And while there is no

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[1] "Plans for Reactors Worldwide," World Nuclear Association, August 2008 <http://www.world-nuclear.org/info/inf17.html> (accessed 27 October 2008). See also Sharon Squassoni, "The Realities of Nuclear Expansion," Congressional Testimony, United States House of Representatives Select Committee for Energy Independence and Global Warming, Washington, DC, 12 March 2008.

[2] The debate is encapsulated in Michael Totty, "The Case For and Against Nuclear Power," *Wall Street Journal*, June 30, 2008, p. R1. See also Diane Farsetta, "The Campaign to Sell Nuclear," *Bulletin of the Atomic Scientists*, 64, 4 (September/October 2008), pp. 38-41; and Charles D. Ferguson, *Nuclear Energy: Balancing Benefits and Risks*, Council on Foreign Relations, New York, April 2007.

[3] See, e.g., "Nuclear Renaissance in Southeast Asia," *NTS Alert*, 2, August 2008; Ferguson, *Nuclear Energy*; and Zia Mian and Alexander Glaser, "A Frightening Nuclear Legacy," *Bulletin of the Atomic Scientists*, 64, 4 (September/October 2008), pp. 42-47, 57.

[4] John Mueller, "Six Rather Unusual Propositions about Terrorism," *Terrorism and Political Violence*, 17, 4 (Winter 2005), p. 495.

history of nuclear terrorism, there is a rich history of nuclear terror."[5] Yet it is also true that the improbable periodically takes us by surprise. The events of September 11, 2001 would have seemed far-fetched had here been speculation about them on September 10. It is only after a completely unexpected catastrophic event has occurred that hindsight tell us that there were in fact advance clues to its coming.[6] It is important, therefore, to watch for early warning indicators and to avoid the psychological refuge of denial ("it won't happen to us").[7]

In the current context, there are early warning indicators that indicate the wisdom of avoiding complacence. These include: (i) the widening availability of targets (NPPs); (ii) growing instability in a number of Asian sub-regions that are experiencing social and political crisis, resulting in terrorist violence; (iii) increasing incidence of indiscriminate destruction, including suicide bombings on a large scale; (iv) known interest in weapons of mass destruction among terrorist groups; (v) the existence of a market for materials to produce chemical, biological and radiological weapons; and (vi) the periodic resort to actual use of unconventional weapons by terrorist groups. Thus, to avoid an "inevitable surprise," it would be sensible to anticipate it, to understand what the potential effects of attacks on NPPs might be, and take preventive and ameliorative measures against it.

NPPs as Targets

Attacks on NPPs can be directed against the main reactor building, but also against less well-protected spent fuel storage sites, which are outside the main structure. Transportation systems are also susceptible to attack. An NPP is vulnerable to attack in several ways:

Ground attack: An assault team that is well-armed and has the advantage of surprise could launch an attack that might be successful against a well-guarded plant, as shown by experience from mock attacks carried out in the United States and India. A second possibility is that the use of a powerful truck bomb could destroy the cooling systems and breach the containment structure of a reactor. While most spent fuel pools are underground, they are vulnerable. Should the cooling system be damaged, or if a crack allows the cooling water to escape, the spent fuel would either melt or burn, causing radiation to spread. In the case of dry storage, spent fuel casks can be blown up by terrorists to spread radioactivity.

Water-based attack: Nuclear plants are often based close to water sources and are exposed to attacks by boat. Terrorists may use the water to approach the facility for a ground assault. Alternatively, though this is much more difficult, they may use shoulder-fired missiles to attack it from a distance. A sea assault is particularly attractive because it

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[5] James Kitfield, "Interview: How I Learned to Fear the Bomb," *Global Security Newswire*, 20 October 2008 <http://www.nti.org/d_newswire/issues/2008_10_20.html#1D29B503> (accessed on 21 October 2008).
[6] Peter Schwartz, *Inevitable Surprises: Thinking Ahead in A Time of Turbulence* (New York: Gotham Books, 2003), pp. x-xi.
[7] Ibid, pp. 230-232. The quotes are the author's.

may be easier to elude naval and coast guard vessels guarding maritime approaches than to bypass security on land.

Air-based attack: Technically, in a deliberate 9/11-type crash, the engines of a large civilian aircraft, which are its most rigid parts, could penetrate a reactor containment structure. This is the most difficult form of attack since it would involve the task of gaining control of a large aircraft and guiding it accurately to hit a relatively small target low on the ground. For this reason, the United States Nuclear Regulatory Commission ruled in January 2007 that American NPPs do not require special measures to protect against such an attack.[8] Nevertheless, air defence and strong construction could together prevent such an event from causing devastating damage.

Threats to Transportation Systems: Nuclear material has to be transported to reactor sites (and also moved within it). During transportation, it is susceptible to attack. Methods of attack may include using armour-piercing shells to penetrate storage casks; capturing and blowing up casks; destroying the transportation infrastructure such as a bridge or tunnel during movement of nuclear material; and causing derailment of railway wagons carrying such material.

Insider Threats: A serious potential threat to nuclear facilities comes from insiders. The range of possible threats includes theft of materials; support to outsiders by way of disruption of alarm systems; sabotage of facilities or specific processes (such as reactor cooling systems); and simple acts such as providing building layouts or access codes to terrorists. Most NPPs are also vulnerable to cyber-security threats. Information on any aspect of a nuclear facility from design to security measures could be misappropriated by an insider. Insiders with technical knowledge may be in a position to help terrorists to build RDDs or at worst even nuclear weapons. It is known for instance that Pakistani scientists were approached by Osama bin Laden for information on nuclear weapons and that they did interact with him, though it is believed that these meetings did not result in a technology transfer of any consequence.[9]

Attacks on NPPs: Potential Effects on Human Security

Attacks on NPPs could have the following effects:[10]

Physical Impact: It is difficult to estimate the physical damage from an attack on an NPP. This depends on various factors such as the precise nature of the explosion, the type of plant, and prevailing weather conditions. The main effects would be caused by the release of radioactive iodine and caesium. The former poses a threat during the first few weeks following its release, while the latter, which can be absorbed into plant life and the food

[8] Steven Mufson, "Nuclear Agency: Air Defenses Impractical," *Washington Post*, January 30, 2007.
[9] David Sanger, "Nuclear Experts in Pakistan May Have Links to Al-Qaeda," *New York Times*, December 9, 2001; Peter Baker, "Pakistani Scientist Who Met Bin Laden Failed Polygraph, Renewing Suspicions," *Washington Post*, March 3, 2002.
[10] Portions of this section drawn on Rajesh M. Basrur and Hasan-Askari Rizvi, *Nuclear Terrorism and South Asia*, Occasional Paper, 25, Cooperative Monitoring Center, Sandia National Laboratories, Albuquerque, NM, February 2003.

chain, may pose a risk for hundreds of years.[11] A study undertaken by the Union of Concerned Scientists (UCS) for the Indian Point NPP close to New York City has calculated that, in the event of a major terrorist attack, the number of immediate deaths from acute radiation syndrome would be (at near-worst conditions) 44,000 and long-term deaths from cancer would be (again, at near-worst conditions) 518,000.[12] Intense gamma rays cause tissue damage and acute radiation poisoning. Low levels of gamma rays can cause genetic mutations leading to cancer. Alpha particles emitted by plutonium and americium are serious health hazards, especially if these are inhaled, causing damage to lung tissue.[13] Inhaled plutonium can cause lung, bone, thyroid, and liver cancer, which may surface after some time, perhaps after years. In certain cases, the effects of exposure to radiation may not appear for several decades. People may continue to suffer from the consequences for a very long time after the exposure. Health problems will continue to afflict the affected population, often surfacing years after the incident.[14] Children born to people suffering from radiation exposure may inherit genetic effects, which need to be distinguished from the somatic effects suffered by exposed persons.[15]

Psychological Effects: The psychological impact of an attack that results in high levels of radiation exceeds the radius of deaths and injuries. "It is a weapon of terror, fear and panic and disruption rather than one of mass destruction."[16] Deaths and injuries may be confined to the immediate vicinity of the explosion, but fear will cause panic in a much wider area. For ordinary people, fears of the unknown and the unseen can be a source of intense personal insecurity. A rumour of an airborne radioactive release that poses serious health hazards would be enough to create panic, causing many people to flee the area. Commenting on the psychological impact of radiological terrorism, John W. Poston, Sr. observes, "You can think of all kinds of things, people panicking, killing each other in …, arguing over who has the right of way, crazy things that would have nothing to do with radioactivity but would be caused by psychological effects."[17] Studies show the likelihood of distress responses, such as fear, insomnia, impaired concentration and a range of ailments that fall under the rubric of Multiple Idiopathic Physical Symptoms (MIPS); behavioural changes, such as fear of travel, increased use of tobacco and alcohol, and compulsive use of medication; and psychiatric illness, notably post-traumatic stress

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[11] United Kingdom, Parliamentary Office of Science and Technology, "Terrorist Attacks on Nuclear Facilities," July 2004, p. 3 <http://www.parliament.uk/documents/upload/POSTpn222.pdf>.

[12] Edwin S. Lyman, "Chernobyl on the Hudson? The Health and Economic Impacts of A Terrorist Attack at the Indian Point Nuclear Plant," Union of Concerned Scientists, September 2004 <http://www.ucsusa.org/global_security/nuclear_terrorism/impacts-of-a-terrorist-attack-at-indian-point-nuclear-power-plant.html>.

[13] Testimony of Dr. Henry Kelly, President Federation of American Scientists, United States Senate, Committee on Foreign Relations, March 6, 2002 <http://www.fas.org/ssp/docs/030602-kellytestimony.htm> (accessed 27 October 2008)

[14] Merril Eisenbud and Thomas Gessell, *Environmental Radioactivity from Natural, Industrial and Military Sources*, 4th edn (San Diego: Academic Press, 1997), p. 15.

[15] Ibid., pp. 15, 22-38.

[16] Don Oldenburg, "How Bad Would 'Dirty' Bomb Be?" *Washington Post*, June 13, 2002, p. C01.

[17] Matthew L. Wald, "Fear Itself is the Main Threat of a 'Dirty' Bomb," *New York Times*, June 11, 2002 <http://query.nytimes.com/gst/fullpage.html?res=9500E2D8113DF932A25755C0A9649C8B63> (accessed 11 June 2002).

disorder (PTSD), acute stress disorder (ASD) and severe depression.[18] There is also the possibility of mass psychogenic illness – psychosomatic symptoms such as nausea, difficulty in breathing, and paralysis – spreading rapidly through large sections of the population.[19]

Economic Impact: The economic costs of a major attack in or near an urban centre are also potentially very high. This would involve large-scale relocation of people and expensive cleanup. As an indicator, the UCS study cited above estimates that for New York (in 2004) this could be as high as $2.1 trillion.[20] The cascading effects on economic life would severely affect business activity, real estate values, stock markets and exports. A major problem is likely to be the spiraling of insurance rates.[21] Insurance companies will be inundated with claims for human and material losses caused by the radiological attack. They may be reluctant to seek new business, or may raise insurance premiums for the affected area. The consequences for employment would be negative. Even if the affected area were declared safe for human beings, it would suffer from a crisis of public confidence. People may not want to return to the area. Tourists and other visitors may continue to stay away. The affected country's exports will almost certainly be hurt. Other countries will be reluctant to purchase processed food and agricultural products from a country that has experienced a nuclear-terrorism attack, fearing that these may be contaminated by radiation. As additional controls are imposed on immigration, the movement of people will be restricted. Slowing down the movement of goods, services, and people has adverse economic implications for ordinary people and their ability to make a living. In developing countries, the effects are likely to be severe.

Political Effects: Political effects are harder to predict. Citizens may remain calm and largely inactive. On the other hand, it is entirely possible that they may panic, resort to violence (possibly, mass violence against a cultural group held responsible) and question the legitimacy of their governments. In the event that the perpetrators are identified as belonging to or in some way assisted by another state, there would be strong pressures for war. An unplanned mass migration could cause shortages of food, water, medicine, and fuel for transport. Frustration and anger caused by these difficulties could lead to violence. The government's failure to cope with the consequences of nuclear terrorism may exacerbate existing social, ethnic, linguistic, and regional cleavages. These tensions could lead to inter-ethnic or inter-communal riots, especially if members of a minority community are viewed as being linked with an act of nuclear terrorism. Public perceptions about the government's failure to cope with the consequences of nuclear terrorism may exacerbate existing social, ethnic, linguistic, and regional cleavages. A government may attempt to deflect public anger by targeting specific sections of society, especially minority groups. More generally, states tend to react viscerally against major security threats. In the event of a radiation disaster caused by an attack on an NPP,

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[18] Igor Khripunov, "The Social and Psychological Impact of Radiological Terrorism," *Nonproliferation Review*, 13, 2 (July 2006), pp. 294-300.
[19] United States, Department of Homeland Security, *Fear of Terrorist Attack Could Trigger Mass Psychogenic Illness*, 5 July 2006.
[20] Lyman, "Chernobyl on the Hudson?"
[21] For details, see *Economic Perspectives on Terrorism Insurance*, Report of the Joint Economic Committee, US Congress, Washington, D.C., May 2002.

governments will be prone to take repressive measures such as arbitrary arrests and torture of suspects and in general undermine the rule of law, all of which violates human security.

Policy Responses

In order to prevent or at least lower the risk of catastrophe arising from an act of terrorism arising from the vulnerability of NPPs, a range of measures can be (and in many cases have been) adopted. In brief, these include:

Enhanced Physical Security: Every NPP has a Design Basis Threat (DBT) or blueprint for its physical protection against attack and against diversion of sensitive materials. This has to be maintained at a high level for the numerous contingencies described above. The physical security system "deters, detects and denies" access to the plant by unauthorised individuals.[22] Normally, security is graded in concentric circles and access becomes more restricted as one goes inward. Human as well as mechanical and electronic barriers are put in place. Air defence and defence against water-borne threats are also provided. Mock attacks and training to defend against these are essential components.

Personnel Security: Along with access controls, which become more stringent within each succeeding inner circle, controls over personnel are also tightened. An effective personnel reliability programme (PRP) should include regular background checks for criminal and narcotics history, but also stress and personality evaluations, again on a regular basis.

Security Culture: It is imperative that all employees of an NPP, including those doing non-essential work, be imbued with a security culture that includes awareness of the threat, what to do in the event of suspicion, how to respond to a crisis, and encouragement to blow the whistle if lapses occur. The last is often difficult to implement as organisations tend to cover the tracks of failure and even punish whistle blowers.

Disaster Response: Governments (along with private owners of NPPs, if that be the case) must be prepared for attack and for potential failure of the protection system. This requires counter-terrorist forces, technical teams to trace and contain fallout, and specially trained first responders such as police, firefighters and medical personnel. Most states are already organised for disaster management in response to natural and some artificial disasters. These systems have to be extended to the threat of radiological disasters. Key personnel have to be given special training for tackling radiological emergencies.

Intelligence: Intelligence forces have to be tasked with assessment of the potential of specific groups for nuclear/radiological terrorism. This is an area of particular concern because the risks are often held to be negligible when in practice major terrorist incidents have periodically taken us by surprise. After "9/11," the realm of the probable has been

[22] Herbert Dixon, "Physical Security of Nuclear Facilities, Nuclear Control Institute," p. 194. <http://www.nci.org/pdf/nt-book/Dixon.pdf> (accessed 22 October 2007).

greatly expanded. The links between terrorism and organised crime are particularly important. In many cases, criminal groups have been associated with trafficking in nuclear materials.[23]

Organisation: Two aspects are important here. First, there is a need for vertical and horizontal links between organisations connected to the security of NPPs: government and private; local, regional, national and international. A nodal body at the national level to assess threats and responses is desirable. Second, the NPP and indeed the entire nuclear power infrastructure must be subjected to independent regulation to prevent the technocrats controlling NPPs from evading accountability. Excessive secrecy and lack of accountability in the name of security undermine efficiency and thereby actually reduce security.

Legal Framework: States building a nuclear energy infrastructure need to develop a legal framework that provides for imposing controls and metes out deterrent punishment to those who evade or violate controls.

International Cooperation: NPP vulnerability is not a single-country problem. It is potentially always international in that (a) the sources of threat (terrorist and criminal groups) may be based abroad or receive assistance from outside the country; and (b) the impact of a major terrorist incident exploiting NPP vulnerability may be felt outside the country where it is located, for radiation knows no borders. At both bilateral and multilateral levels, the potential benefits include sharing of best practices, intelligence sharing, legal benefits (such as extradition) and technical equipment and training.

Conclusion

To avoid the unpleasantness of "inevitable surprises," policy makers must recognise that the expansion of nuclear energy in a world characterised by political instability and a predilection among some groups for indiscriminate violence brings risks that carry high potential costs. The major obstacles to appropriate responses are likely to be denial and a consequent failure to take preventive (and reactive) measures. As a result, the security of ordinary people is likely to be damaged in the many ways outlined in this paper. The costs of preventing such attacks are not extraordinarily high. Policies designed to develop nuclear energy are ultimately geared toward the well being of the public. They must take into account the risks they pose to the same public when they build NPPs.

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[23] Rens Lee, "Why Nuclear Smuggling Matters," *Orbis*, 52, 3 (Summer 2008), pp. 434-444.