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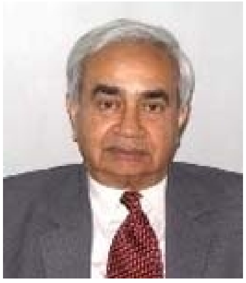

Technology and Nuclear Proliferation
The Problem from Laser Enrichment

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Technology is Janus-faced, so named after the Roman god with two faces looking in opposite directions--eastwards and westwards, symbolizing the imperative need to simultaneously view the past and the future, beginnings and transitions, endings and time. Janus was also the benign god of doorways. His two faces looked outwards into the street and inwards towards the house.

The same is true of technology. It has two faces that look in opposite directions; it can find use for development, but also for conflict. Everything depends on the intentions of the progenitor. We are concerned here with the Janus-nature of nuclear technology and, more specifically, with the recent news that laser-based uranium enrichment has finally reached the stage of fruition.

General Electric has succeeded now in harnessing this technology on an experimental basis to enrich uranium. It has also applied to the U.S. Nuclear Regulatory Commission to permit a $1 billion commercial plant to be constructed for producing reactor fuel. Enriched uranium, meaning uranium in which the percentage of the desired isotope U-235 has been concentrated, has multiple uses. U-235 only constitutes 0.7% in the ore which exists in nature. Hence, it needs to be enriched to 3% for generating electricity, 20% to power submarines, and to over 85 % for making nuclear weapons. Uranium enrichment is generally undertaken by using centrifuges to separate the desired isotope U-235 from its other isomers, which requires large facilities to be established that utilize huge amounts of electricity. They are, therefore, easily detectable.

Laser technology allows uranium to be enriched in smaller locations that are easier to conceal, unless this activity is undertaken on a commercial scale. Consequently, angst has arisen in the international nuclear regime that aspirant nations or non-state actors i.e. extremists professing various political and religious hues that are desirous of acquiring nuclear weapons capabilities could exploit this technology for weapons purposes.

It is apparent that the chief obstacle to acquiring nuclear weapons is access to weapons-grade fissile material like U-235 or Plutonium-239; hence their acquisition is an unavoidable first step towards achieving nuclear capabilities. Consequently, the proliferation pessimists have raised the red flag. They warn that aberrant nations like Iran could establish a clandestine laser enrichment plant and, indeed, there is some evidence of Iranian scientists working in this direction. Hence, these proliferation pessimists argue that a new and convenient route has been found to the bomb. Besides, this technology would interest non-state actors linked to Iran, but also the al Qaeda that has long shown interest in acquiring nuclear weapons and other Weapons of Mass Destruction (WMD), and their related technologies.

The other and benevolent Janus face to laser enrichment is that it enables the generation of nuclear power, which is environmentally clean; it is therefore to be preferred to fossil fuels (coal and oil), which generates pollutants like carbon dioxide, sulphur dioxide and particulate matter that exacerbate climate change, and are hazardous to health. Moreover, laser enrichment is still at the laboratory-stage; so, scaling it up to industrial levels lies in the uncertain future. Any attempt to set up a laser enrichment plant of some consequence for proliferation would soon be discovered. The proliferation optimists are, therefore, reasonably assured.

I
MAJOR ISSUES

Where does the truth lie in this matter? Are the dangers from laser enrichment technology coming of age realistic? Or are these dangers being exaggerated? What exactly is the nature of the threat? Three questions need examination before appropriate conclusions are reached

First, the acquisition of highly enriched uranium is, undoubtedly, the first critical step towards acquiring nuclear weapons capabilities. But, other steps remain to be mastered like 'shape technology' or the actual construction of the nuclear explosive device from the fissile material. The art here lies in holding together a 'critical mass' of the fissile material long enough for it to be triggered and the chain reaction to be initiated, which leads on to the nuclear explosion. The two processes used for this purpose are the 'gun barrel' method in which two sub-critical masses are propelled together to produce a critical mass, and the 'implosion' technique where several 'lenses' consisting of conventional explosives are uniformly detonated to compress a sphere of sub-critical mass into a critical mass.

These further technological steps to fashion an explosive device are by no means trivial. Competent technical opinion holds that these steps could become available to nation-states with their greater economic and technical resources, apart from access to foreign technology, but they are much beyond the capacity of terrorist organizations, even if they are assisted by rogue scientists. Possessing the 'science', in brief, is not enough; the relevant 'technology' must also be available, which requires the existence of an industrial infrastructure and is quite beyond the capacity of non-state actors.

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Second, the possibility of terrorist organizations gaining access to functioning nuclear weapons is often debated in the literature. But the probability of this occurring is quite remote. Why? Quite simply because nuclear weapons are obviously the Crown jewels in the national weapons inventory. Hence, they would be guarded by multiple layers of protection and those guarding them would be subject to some kind of personnel reliability program to ensure their suitability, apart from allegiance to the ruling regime.

Besides, in appreciation of the need for maintaining nuclear safety, these weapons could be stored in a dis-assembled state in different locations, and in a different location from the delivery systems like aircraft and/or missiles. Similar physical safety arrangements would also apply to stockpiles of weapons-grade fissile materials. There are some residual concerns about the security of both weapons and fissile materials in movement from one storage center to another. But, several precautions are being observed to ensure that nothing untoward happens en route.

Third, the scenarios that are plausible but are considered unthinkable are somewhat different, and relate to the possibility of nuclear weapons or fissile materials being deliberately provided by one nuclear weapon state to another. This has occurred in the past between the United States and the United Kingdom. It is also believed that China provided the design of the nuclear device used in its fourth missile delivery test to Pakistan. A corollary to this state-to-state nuclear weapons transfer scenario is the possibility of nuclear weapons or fissile materials transfers by states to non-state actors, which is possible, but it unlikely since the source would be easily traced. The real nightmare scenario that is troubling the international nuclear regime arises from the State itself falling under the control of extremist elements. They could be guided by obscure political agendas or apocalyptic visions of a New World that requires the Old World to be obliterated.

Apropos, Dr Jack Caravelli, an adviser to several US Presidents, has revealed that secret plans exist in the United States to seize Pakistan's nuclear weapons in case such an unthinkable scenario take shape. The fact that Pakistan's nuclear assets are believed to be maintained in a dis-assembled state and distributed over several locations makes their seizure by the United States complicated;

equally, it makes their protection by Pakistan difficult.

II
PARSING THE THREAT: RDDS?

The laser enrichment of uranium, therefore, will add to these burgeoning problems. But, proceeding deeper could enriched uranium, and, for that matter, weapons grade plutonium, which is also used for making nuclear weapons, be utilized to make Radiological Dispersal Devices or RDDs? They are commonly referred to as 'dirty bombs'. RDDs can be triggered by a conventional explosive, or dispersed by mechanical means like crop duster airplanes or inserted into buildings through air-conditioning vents.

Strategic analysts are of the opinion that, since nuclear weapons are not easy to either steal or manufacture, the easier option for terrorists would be to use fissile materials like uranium or plutonium to make RDDs? Even if their damage potential is localized, and nowhere on the same scale as nuclear weapons, RDDs have the ability to cause widespread panic, and require costly clean-up operations. It is relevant to point out here that the soil around the Chernobyl reactor, where a major accident had occurred in 1986, cannot still be used for either agriculture or grazing cattle. A nightmare scenario envisages terrorists disseminating radioactive material across a large area, which would, apart from causing widespread panic, lead to loss of wages and business, force the demolition of contaminated buildings, and require the disposal of contaminated rubble and decontamination chemicals.

Due to their potential disruptive effects RDDs have been classified as Weapons of Mass Destruction (WMDs) by a U.N. Commission since 1948, along with chemical, biological, and nuclear weapons. Some analysts argue that RDDs should be classified as Weapons of Mass Disruption, and not Mass Destruction, since they do not have the potential to cause the extensive damage to life and property, which is a characteristic of nuclear weapons. But, this might be understating RDDs. Incidentally, the US Congress has been very sensitive to possibility of terrorist attacks with RDDs against the United States after 9/11.

Reverting back to the implications of the laser enrichment of uranium, it should be noticed that enriched uranium can be used to fashion RDDs, but it is not considered the ideal material for this purpose from a technical viewpoint. The radiation emitted per gram of enriched uranium is small; hence the biological hazard is limited. Plutonium is far superior for this objective due to the alpha particles emitted that are extremely poisonous—even a small quantity, if inhaled, could be fatal. Spent reactor fuel, which contains a mixture of uranium and plutonium isotopes, is probably the easiest material available for making RDDs.

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But there is another aspect to this proliferation threat that is not being recognized. Reactor wastes, prominently cesium-137 and strontium-90, can be chemically separated from the spent fuel. Besides, reactors can also be used to convert cobalt-59 into cobalt-60. These radioactive isotopes are capable of being manufactured commercially, and transferred in sealed containers (metal capsules), to ensure that they do not contaminate people or pollute the environment.

They have many useful applications, in that they can be used to treat cancers, preserve food by irradiation, monitor wells for oil, create radiographs for inspecting cargo containers, and utilized for medical and agricultural research. But, they can also be used for malign purposes by anti-social elements.

From the perspective of terrorists it is easier to obtain these radioactive materials by theft or purchase from insiders. Despite being in sealed containers, the widespread distribution of these radioactive sources adds very considerably to the danger of their getting lost due to either carelessness or malfeasance, since these sources are located in open environments like hospitals, universities and research establishments that are accessible to large numbers of authorized persons. By their intrinsic nature, these facilities are harder to protect than military installations or nuclear power plants that have inbuilt security measures. The dangers of leakages of radioactive materials from these widely distributed facilities are multiplied by the need for long-term storage of excess or depleted or unwanted sources is steadily increasing worldwide. The case of cobalt-60 source material being found in a West Delhi scrap market in 2010 underlines the dangers of their being lost or forgotten unless strict accounting measures are enforced.

Further, it would be futile to expect that these dispersed institutions holding radioactive materials have the trained operators to sound the alarm or trained response teams available to swing into action in cases of accidents and terrorist attacks. An appropriate local response requires such incidents to be detected and properly identified, and the first responders to know what remedial actions have to be taken. Otherwise, it might become too late to deal with leakages of radioactive sources should a crisis occur, which would require proper consequence management. A global need obtains for countries to appreciate the threat arising from the widespread availability of radioactive sources; the need to protect them cannot be over-emphasized, as terrorists do not respect territorial boundaries.

III
CONCLUSIONS

Undoubtedly, the recent success in achieving the laser enrichment of uranium opens up another route to acquiring the wherewithal to manufacture nuclear weapons. A nuclear aspirant could use this technology for meeting its ambitions, but there is little reason, realistically, for it to prefer this technology to the easier and more proven technologies for enriching uranium like centrifuge enrichment. The belief that laser enrichment can be accomplished in laboratories to demonstrate the technology is true; but the quantities produced would hardly suffice to establish a nuclear arsenal unless commercial scale facilities are established that would be difficult to conceal. The possibility of terrorists acquiring this technology and using it to pose the danger of nuclear terrorism is remote.

A technical evaluation of laser enrichment and the realistic dangers it poses for nuclear proliferation has been requested by the American Physical Association of the Nuclear Regulatory Authority in the United States. A similar exercise could be attempted by India’s Atomic Energy Commission. More specifically, the Atomic Energy Regulatory Board could undertake this exercise--it is currently undergoing a drastic revision of its charter in that it would report directly to Parliament, and not to the Atomic Energy Agency, as heretofore