The risk of nuclear terrorism

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Over the last few years I wrote several papers, and made many presentations, on the risk of nuclear terrorism [1-10]. The present text, written at the request of the organizers of three recent conferences to which I participated (the USPID International Conference in Castiglioncello, Italy, 18-21 September 2003; the XV Amaldi International Conference in Helsinki, Finland, 25-27 September 2003; the Workshop on "New Initiatives for Risk Reduction on Unsettled Asian Borders", Skavsjoholm near Stockholm, Sweden, 26-29 September, 2003), has been drafted mainly to bring attention to these previous publications of mine [1-11], as well as to an important recent paper [12] that provides an overview of the technical opportunities for a sub-national terroristic group to acquire the capability to manufacture a nuclear explosive device (a most competent overview: Albert Narath served until recently as Director of the Sandia National Laboratory, the installation where the USA nuclear warheads are manufactured).

The main point of these publications [1-11] is that it is quite easy to build a nuclear explosive device if a sufficient quantity of (weapon-grade) Highly Enriched Uranium (HEU) is available. To reach this conclusion – which has the nature of a scientific truth – one must realize that a primitive nuclear explosive device is much easier to manufacture than a nuclear weapon produced for employment in a military context by a State: the nuclear explosive device need not be transportable nor sturdy (it will be most conveniently manufactured in a rented locale in the target city), it need not be reliable (its yield might be *a priori* unpredictable, but with a significant probability that it be of the order of that of the Hiroshima bomb), it need not have any security/safety gadgets (but given the low radioactivity of Uranium it will be manufactured with minimal health risks), it will be exploded via a timer (to allow an easy getaway) that need not have any great precision. The ease to manufacture such a device is guaranteed by the fact that all one needs to do to produce a nuclear explosion of Hiroshima type is to cause sufficiently fast assembly (in a time of the order of, say, a millisecond) of a supercritical mass of HEU, possibly with a tamper around it in order to reduce the critical mass and to facilitate the supercritical mass remaining assembled for a sufficiently long time (say, of the order of a second) so as to guarantee that a cosmic ray neutron start the chain reaction (note that this implies that there is no need of a neutron source to initiate the chain reaction [12] -- indeed no neutron source was featured by the six HEU nuclear weapons manufactured by South Africa using the gun-type configuration -- nor was the neutron

source indispensable for the initiation of the chain reaction in the Hiroshima bomb [13]).

All the additional materials besides HEU will be easily available in the open market (except possibly for some conventional explosives, easily available on the black market -- if they are indeed needed). Nor will any expertise in the manufacture of nuclear weapons be needed (although it would of course facilitate the task); nor any knowledge of nuclear or material sciences will be needed besides what any intelligent bricoleur may easily get from the open literature (available in books and via internet).

Fortunately there is a barrier to be overcome before a subnational terrorist group acquire the capability to destroy a city via a nuclear explosion, namely the difficulty to get hold of the required quantity of HEU. This presumably explains why a nuclear catastrophe has not yet happened. But complacency in this respect is most unwise -- although the skepticism about the likelyhood of a catastrophe of new type happening is always overwhelming, so that it is unlikely that the threat of nuclear terrorism caused by a subnational commando will be taken adequately seriously *before* a catastrophic instance of it will happen.

One hundred kilograms of weapon-grade HEU will be more than enough to manufacture a primitive nuclear explosive device. Once this amount of HEU is acquired by a terroristic commando, smuggling it anywhere is a trivial task, facilitated by its small volume (less than *ten* liters) and marginal radioactive signature.

This amount of HEU must be compared with the existing stocks of this material, which in Russia alone exceed *one million* kilograms.

These figures speak for themselves. They entail that there should be a determined effort focussed on guaranteeing the physical security of this material against any diversion, and also focussed on eliminating as much of it as possible as quickly as possible. While some steps in this direction have been taken, much less has been and is being done than would be possible and appropriate, given the magnitude of the threat. (For more information on this I refer to the papers quoted above, and as well to a forthcoming study by an expert group convened by the Swedish government [14]).

It is moreover remarkable -- although to some extend understandable due to certain industrial and commercial interests -- that more attention has been and is devoted, rather than to the elimination of HEU, to the elimination of Plutonium, the other material suitable for the construction of a crude nuclear explosive device; although in this case the device cannot be so simple, so that the likelyhood that a Plutonium device be manufactured by a sub-national terrorist commando is moot ("Most people seem unaware that if separated U-235 is at hand it's a trivial job to set off a nuclear explosion, whereas if only plutonium is available, making it explode is the most difficult

technical job I know". Luis W. Alvarez, key physicist in the Manhattan project, and subsequently Nobel laureate in physics, in his memoirs written in 1987, one year before his death [15]).

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