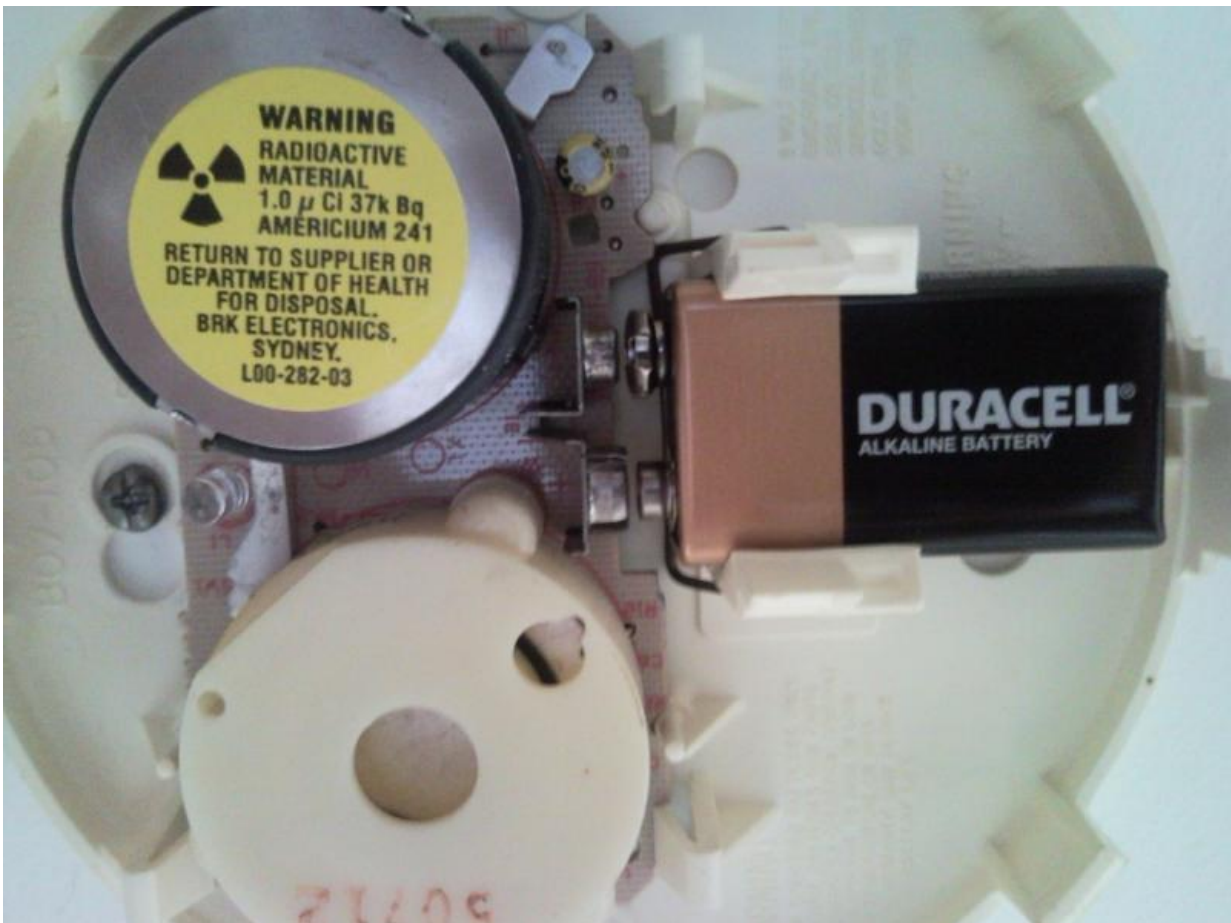


Explainer: What is a dirty bomb and how dangerous is it?

April 6 2016, by Robert J Downes



Americium-based smoke detector. Credit: MD111/wikimedia, CC BY-SA

The worrying news that individuals affiliated with the so-called Islamic

State have undertaken hostile surveillance at a Belgian nuclear research facility has created growing speculation about the group's [nuclear ambitions](#).

Nuclear weapons and dirty bombs are frequently mentioned in the same breath. However, they are two distinct technologies. Understanding the differences between these weapons and the damage they can cause can ground speculation in reality – and help us work out the most likely route a terrorist organisation such as Islamic State may take in the future.

There are two types of actual nuclear weapon – fission and thermonuclear devices. Fission bombs are fuelled with fissile material such as uranium and plutonium. When detonated, the atoms in the weapon's core split and release huge amounts of energy – producing a nuclear explosion. Thermonuclear weapons use a fission bomb to ignite special fuel, consisting of light hydrogen isotopes. These nuclei are forced together – undergoing nuclear fusion – releasing an even larger explosion.

There are [no indications](#) that a terrorist group has obtained any fissile material to date. If they could it would be possible for them to build a fission device, although this does pose a huge technical challenge. While highly engineered weapons need only [a few kilograms](#) of fissile material, a crude terrorist-built design would require far more. Thermonuclear weapons, on the other hand, are too complex for terrorist groups to develop.

An easier option for a terrorist group would be to build a dirty bomb or, technically, a radiological dispersal device. These do not rely on complex nuclear reactions. Instead, conventional explosives are used to disperse radioactive material, contaminating an area with elements such as radioactive isotopes of cobalt, caesium or americium.

Under the command of Shamil Basayev, a Chechen separatist leader, militants [buried a dirty bomb in a Moscow park](#) in 1995. Basayev threatened to turn Moscow into "an eternal desert" unless his demands were met. The weapon was not detonated. The episode was a terrorist publicity stunt – threatening to use unconventional weapons against Russian civilians. But it did show that a dedicated group could build and use a dirty bomb.

How dangerous is a dirty bomb?

Although dirty bombs do not produce catastrophic explosions they can nevertheless be deadly. Radioactive materials produce ionising radiation which can destroy bodily tissues and create harmful mutations that lead to cancer. The danger posed by radioactive material depends on the means of exposure and type of radiation it produces. Alpha radiation is harmful only if inhaled or ingested, while other types – known as beta and gamma radiation – can penetrate and damage human tissue even if the material is external to the body.

In 1987 [two men stole a teletherapy unit](#) from an abandoned cancer clinic in Goiânia, Brazil, believing its parts might have scrap value. The unit contained a heavily shielded [caesium-137 radioactive source](#) which produced high-intensity gamma radiation. When the source was removed from its case, both men received full-body exposure to the penetrating radiation. They worked for several days to remove the caesium, drawn to the fascinating blue glow emanating from an aperture normally used to direct a radiation beam towards malignant tumours.

Experiencing diarrhoea and vomiting from their unwitting exposure (which they attributed to food poisoning) the men gave the caesium to their family and friends as gifts. One father gave the glowing material to his daughter who played with it for several hours. She was one of four individuals to succumb to radiation injuries a short time later.

Twenty people developed [acute radiation syndrome](#) from the exposure. This is characterised by gastro-intestinal symptoms, immune system disruption, potential loss of consciousness and death. Those who handled the caesium also developed [local radiation injuries](#) such as erythema (skin reddening), blisters and ulcers, desquamation (skin shedding) and tissue necrosis (premature death of cells in the tissue).

The event caused widespread panic about contamination in Goiânia. Some 112,000 people (10% of the population) sought help, overwhelming local healthcare services. Decontamination costs ran into tens of millions of dollars, buildings were demolished and contaminated top-soil was removed. Public fears also stoked an unofficial boycott of locally produced goods [which dropped in price by 40%](#) and tourism collapsed.

Despite the International Atomic Energy Agency calling it "[one of the world's worst radiological incidents](#)", only four lives were lost. However, the psychological effect on the population, the protracted clean-up and economic disruption suggest a terrorist [dirty bomb](#) can nevertheless have a huge impact. Over the long term, the effects of contamination have been largely social. Public fears of coming in contact with contamination have led to [discrimination against survivors](#). Yet cancer rates in Goiânia [have remained comparable](#) with other areas of Brazil.

Tackling the threat

Unlike uranium and plutonium, which are stored in high-security facilities and are extremely hard for terrorists to obtain, there are many radioactive materials with common applications. These include cancer treatment equipment found in hospitals, appliances to irradiate food for preservation and pest control, and [smoke alarms](#).

Such wide availability does present a security challenge, so what can we

do about it? A strong, regulatory regime and effective controls on the sale and transport of dangerous radioactive sources can certainly mitigate the threat. Alternative technologies can [sometimes replace radioactive sources](#) used in medicine. Another option is to install radiation detection equipment at ports and border crossings to identify unauthorised transport of dangerous material.

Dirty bombs are certainly easier for terrorist groups to produce than nuclear weapons. This is the reason for [sensible concern](#), rather than [hysterical speculation](#) about Islamic State's recent activities in Belgium and, especially, Iraq and Syria. After all, without an effective government, it is unclear who controls the many radioactive sources in the region.

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