# Nuclear Power and Security Threats

***"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."***
UN Secretary General Kofi Annan, Madrid 10th Mar 2005. [1]

**Introduction**

The terrorist attacks of 11th September 2001 (9/11), alerted the world to the potential of nuclear terrorism - making it "far more likely", according to the UN's International Atomic Energy Agency (IAEA), that terrorists could target nuclear facilities, nuclear material and radioactive sources worldwide.

"*The willingness of terrorists to sacrifice their lives to achieve their evil aims creates a new dimension in the fight against terrorism*," says Mohamed ElBaradei, the Director General of the IAEA [2]

Nuclear facilities have not been designed to withstand a deliberate crash by a jumbo jet full of fuel or many other types of attack. A successful attack could have widespread and catastrophic consequences for both the environment and public health. The extent of damage caused will depend on the type of nuclear facility, the nature of the attack, weather conditions and the success of mitigation measures put in place.

Nuclear terrorism has the potential to cause a large number of deaths, and the risk of a successful attack will increase if more nuclear power stations and radioactive waste stores are built. Indeed there appears to be a growing disconnection between the justifiable international concern over security threats posed by nuclear facilities, and the promotion of an expanded nuclear sector by the very international authorities warning of the risk! [3]

So great is the risk of a terrorist attack on nuclear facilities that some say nuclear power should no longer have a role to play in supplying energy, and that it is not compatible with an open and democratic society. [4] Others have responded by saying that information on nuclear reactors and radioactive waste facilities needs to be withheld, reversing the trend of the last decade in many countries to allow greater openness and transparency in what has traditionally been a highly secretive industry. [5]

**Nuclear facilities as terror targets**

The tragic events of 9/11 finally forced the nuclear industry to acknowledge that nuclear reactors and stores were recognised terrorist targets. Following the attacks, the US Nuclear Regulatory Commission sent a confidential memo to all US nuclear power plants in January 2002 warning of plans for a terrorist attack in which hijackers "*fly a commercial aircraft into a nuclear power plant.*" [6] A taped interview shown on Al-Jazeera TV on 10th September 2002 contained a statement that Al Qaeda initially planned to include a nuclear plant in its 2001 attack sites. [7]

Despite this, it took a US Court in June 2006 to force the Nuclear Regulatory Commission to consider the possibility of a terrorist attack in the preparation of an Environmental Impact Statement for a waste storage project at the Diablo Canyon nuclear plant in California. [8]

The UK Government's Office of Civil Nuclear Security (OCNS), in its 2003 Annual Report, reported on two Greenpeace incursions into the Sizewell B nuclear power station site in Suffolk on 14th October 2002 and 13th January 2003. These incursions were designed by Greenpeace to highlight the fallibility of security arrangements. Even after the first incursion, the station operator failed to make the necessary improvements to security. [9] The following year, OCNS said, whilst noting the threat of terrorist attack is currently high, that the measures taken to enhance security "*…would not prove effective against armed terrorists, for which other measures are taken*." [10] OCNS reported 39 lapses in security against terrorism in the year up to March 2006, including laptop thefts, internet misuse, and a power cut. OCNS has warned of "complacency" on leaks of sensitive nuclear information. [11]

**Nuclear plots**

Several recent events have pointed to the possibility of an attack on a nuclear facility somewhere in the world sooner or later. In the UK the Press reported that detailed plans of sensitive nuclear sites were found in a car linked to one of the suspects arrested after the July 2005 London bombs. The documents appeared to come from lectures given by a nuclear expert in 2002. [12]

Three of eight Sydney men arrested on terrorism charges in Australia in November 2005 had previously been stopped by police near Australia's only nuclear reactor in December 2004, raising the possibility that the Lucas Heights research reactor and its spent fuel store (situated 25 miles south west of central Sydney) may have been a target. [13] When interviewed separately by police in 2004 all three gave different versions of the day's events and police inquiries revealed the access lock for a gate to a reservoir at the reactor had recently been cut. This was not the first time the Australian reactor had been the subject of a suspected terrorist plot. An earlier suspected conspiracy was discovered in March 2000.

Somewhat more dramatically, a foiled Chechen rebel assault on the Russian city of Nalchik in October was reported to have involved an attempt to hijack five planes that could be flown into various targets, including a nuclear power station. [14] Annex 1 lists previous attacks of nuclear facilities around the world.

**Mode of Attack**

Since 9/11 public attention has focussed on the risk of an aircraft being deliberately crashed into a nuclear facility. IAEA spokesman David Kyd pointed out at the opening of the IAEA's 2001 annual conference that:

"*Most nuclear power plants were built during the 1960s and 1970s, and like the World Trade Center, they were designed to withstand only accidental impacts from the smaller aircraft widely used at the time. If you postulate the risk of a jumbo jet full of fuel, it is clear that their design was not conceived to withstand such an impact*." [15]

He also told CNN on 18th September 2001 that:-

*"[Reactors] are built to withstand impacts, but not that of a wide bodied passenger jet full of fuel. . . . These are vulnerable targets, and the consequences of a direct hit could be catastrophic".* [16]

A confidential German Government document, leaked in 2004, showed that no single nuclear reactor in Germany is safe from a terrorist attack and that older reactors would most probably be uncontrollable after a plane crash. Wolfram König, head of the German Radiation Protection Agency (BfS) said that five out of eighteen operational reactors should be closed down 'prematurely' because they posed the greatest safety threat. [17] The German document confirmed the findings of an earlier Greenpeace Germany report. [18] But similar problems will exist in other countries. An assessment of the risks in each country with nuclear reactors should be made public.

**Consequences of an Attack**

The consequences of a successful attack on a nuclear facility would depend on a wide range of variables, such as the type of facility, the extent of the damage and the size of any radiation release; weather conditions; the efficiency of countermeasures. A study by the UK's National Radiological Protection Board (NRPB) on a release from the Sizewell B reactor suggested over a thousand fatal cancers might result with crop restrictions necessary over 1,000km$^2$. An attack on the High-Level Waste (HLW) tanks at the Sellafield reprocessing site in West Cumbria, could result in the need to evacuate population centres as far away as Glasgow and Liverpool. [19] The scale and impact of such a release could vary enormously. A worst-case scenario could be 3.5 million cancer deaths. [20]

Nuclear power plants harbour radioactive materials in spent fuel ponds, which may be in buildings even more vulnerable to attack than the reactors themselves. In most cases spent fuel is stored in ponds on reactor sites, rather than being transported to a reprocessing plant. Fuel for the world's commonest reactor type – the Pressurised Water Reactor - is clad in flammable zirconium. In worst-case scenarios, a successful attack could result in the loss of water from spent fuel storage ponds, leading to ignition of the fuel. [21] According to a US nuclear security specialist, this could result in large releases of radioactivity. A 1997 study done for the US Nuclear Regulatory Commission estimated the consequences of a spent-fuel fire at a pressurized water reactor (PWR) could include 54,000–143,000 extra cancer deaths. [22]

**New reactors**

It might be thought that new reactors would be designed to withstand the impact of a jumbo jet, but a leaked document by Electricite de France (EdF) on the vulnerability to terrorist attack of the new European Pressurised water Reactor (EPR) - being considered or already under construction in several countries including UK, France and Finland - reveals a dangerously flawed approach to security. [23]

Nuclear engineering consultancy, Large and Associates, has assessed the secret EdF document and concluded that it includes seriously flawed assumptions about whether the reactor could withstand a potential terrorist attack using hijacked commercial aircraft. [24]

Of course, as with any nuclear accident, the radioactive fallout would not necessarily be restricted to the country where the reactor is situated. A study on the Wylfa nuclear power plant on the island of Anglesey off the coast of Wales, for example – a site which has been mentioned as a possible host to a new reactor – shows that more than two million Irish people could face compulsory resettlement should an accident occur. [25]

Clearly modes of attack other than crashing a passenger aircraft into a nuclear site should also be considered, such as attacks involving vehicles loaded with explosives, or suicide bombers. [26]

**Nuclear transports**

There are also concerns that terrorists could steal nuclear materials to make a “dirty” bomb, or attack waste in transit. An Al-Qaeda website contains 80 pages of detailed instructions on how to make a “dirty” bomb along with pictures of kitchen bomb-making techniques. [27] At a high profile court case in 1982, it was disclosed that a terrorist cell in the Irish Republic had considered attacking a shipment of spent nuclear fuel en route to Sellafield from the docks at Barrow-in-Furness, Cumbria. [28]

The nuclear industry tranports various kinds of nuclear material around the globe by sea, rail, road and even air. Clearly the industry couldn’t operate without the transport of uranium, and nuclear fuel, but some of the most hazardous transports – of spent nuclear waste fuel and plutonium for example – are almost completely pointless. Nuclear transports involve significant risks to human health and the environment. One cask full of highly radioactive spent fuel elements contains approximately as much radiation as was released by the Chernobyl accident. As well as being vulnerable to accidents, transports could be targets for terrorist attacks or the theft of fissile materials.

Spent nuclear waste fuel from some of the world’s nuclear reactors is transported to reprocessing plants where it is dissolved in nitric acid to allow the separation of uranium and plutonium from the highly radioactive waste. But only around 5 – 10% of world spent nuclear waste fuel is treated in this way. The rest is stored pending a decision about how to dispose or manage it. [29]

Reprocessing is only carried out in a few countries and the largest centres for commercial reprocessing are at Sellafield in the UK and La Hague in France. So within these two countries spent nuclear waste fuel is transported from reactor sites to the reprocessing plants, by road and rail. Despite the need to be more security conscious, several recent incidents in the UK are cause for serious concern.

In October 2005 a cargo of spent nuclear waste fuel from the Hinkley nuclear power station was discovered sitting unprotected in a railway siding near Bridgwater in Somerset for hours, near houses and a school. [30] In July 2006 an undercover journalist managed to plant a fake bomb on a nuclear waste train while it sat unattended in North-west London. [31] Every week, trains carrying this extraordinarily dangerous nuclear waste criss-cross the country. Nuclear engineer, Dr John Large, says:-

"*…every one of these trains would be a potential target for terrorists. The flasks of fuel rods could be easily penetrated by a rocket-propelled grenade. If a flask was penetrated it would cause radiation over a wide area. The contents are intensely radioactive. Exposure for just 30 seconds would mean death.*" [32]

A terrorist attack on a routine transport of nuclear waste in the UK could spread radiation over 100 kilometres, and cause over 8,000 deaths, according to Large. Large & Associates examined potential accidents and acts of terrorism that could severely damage a nuclear waste "transportation flask", causing the release of radioactivity. As the train routes pass through several large UK towns and cities, such as London, Bristol and Edinburgh, tens of thousands of people could be exposed to radiation in such an incident. [33] Greenpeace UK also published timetables for the nuclear waste trains in order to expose their vulnerability to attack [34].

**Marine Transports**

Sellafield and La Hague also carry out reprocessing contracts for some other countries such as Germany, the Netherlands, Switzerland, Belgium, Sweden and Japan. Many of these

reprocessing contracts have been completed. But large stockpiles of plutonium, reprocessed uranium and reprocessing waste continue to build up at the two reprocessing plants. In many cases the reprocessors are contractually committed to returning these materials to the client.

Return shipments of high level waste, solidified in glass blocks, from France to Japan began in 1995, (See Annex 2) but return shipments from the UK to Japan have yet to begin. British Nuclear Group (BNG) is preparing for high-level waste (HLW) returns to Japan starting in the financial year, 2007/08. At least 11 shipments are expected, assuming the Japanese are able to change the law to allow them to import slightly more HLW as a substitute for bulkier lower level wastes. [35]

**Weapons-useable plutonium**

Also of concern are shipments of weapons-useable plutonium back to reprocessing client states, particularly Japan. Japanese utilities have reprocessing contracts with both Sellafield and La Hague, consequently around 33 tonnes of weapons-useable plutonium belonging to Japanese nuclear utilities is currently is storage in Europe. Professor Frank Von Hippel, former Assistant Director for National Security in the White House Office of Science and Technology Policy points out that separation of plutonium for whatever purpose creates the risk of theft by terrorist groups, however stable the host country. [36]

In 1992 1.7 tonnes of plutonium was transported from France to Japan. But this shipment proved to be so controversial that the Japanese Government now aims to have all Japanese plutonium fabricated into MoX (Mixed Oxide) fuel and shipped to Japan. This programme has also confronted big problems in the last ten years, including major opposition from en-route countries. Despite four transports of plutonium in MoX fuel since 1985, not one gram of plutonium has been loaded into a Japanese reactor. [37] (See Annex 2) It would be a relatively straightforward matter to undertake chemical separation of plutonium from MoX fuel, [38] so returning plutonium as fabricated MoX fuel has failed to quell concerns that a shipment could be a terrorist target.

In 2004 140kgs of weapons-grade plutonium was transported across the Atlantic on the UK-flagged commercial nuclear cargo ship, the Pacific Pintail, from Charleston, South Carolina, USA. It then travelled by truck more than a thousand kilometres across France, passing by numerous highly populated communities to Cadarache where it was fabricated into MoX fuel rods, before being transported back to the US in 2005. The shipment was a totally unnecessary test and was highly vulnerable to accidents or deliberate attack. [39] The convoy's journey across France was assessed by a U.S. nuclear security expert who concluded that it was at "high" risk from terrorist attack, with inadequate security protection. [40]

This experimental shipment was a one off, but in France, MoX and plutonium shipments are routine and predictable. Each shipment contains the equivalent of 40 Hiroshima bombs per convoy, that cross France every week to ten days. [41] The above security assessment concluded that for these shipments have no effective security, and the level of risk is categorized as "extreme." A report, by Large and Associates, evaluates several scenarios, including road collisions, tunnel fires, and terrorist attacks, which might accidentally or intentionally release plutonium into the atmosphere. The report models resulting plumes from two sites, one outside Paris and one outside Lyon. Beyond the immediate deaths from the hypothetical attack, the Large report estimates that 11,000 people would die of long-term effects from radiation exposure. [42]

**Increased Security**

Increased security is not necessarily the answer to these problems. In the UK armed police now patrol civil nuclear sites, including those run by the privatised nuclear operator, British Energy, whereas before 9/11 they would have only been at a small number of particularly sensitive sites such as Sellafield and Dounreay which both have stockpiles of plutonium. This increased security is beginning to provoke a debate about the impact it will have on civil liberties. Armed officers patrolling outside of the perimeter fence, for example, have made visitors to the beach near the Sizewell nuclear station, uneasy. The Civil Nuclear constabulary has refused to say whether it has a "shoot to kill" policy. [43]

With increasing calls for restrictions on information regarding nuclear reactors and radioactive waste facilities since 9/11, such moves would reverse the trend of the last decade in many countries to allow greater openness and transparency in what has traditionally been a highly secretive industry. [44] This raises questions about whether nuclear power should continue to play a role in an open and democratic society. [45]

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**Annex 1 Previous Incidents**

To date, it is known there have been six direct attacks on nuclear power plants in France, South Africa, Switzerland, the Philippines, and Spain (there may have been others which have not been made public knowledge). Fortunately, all of the reactors were in the early stages of construction and were not operational. The International Policy Institute for Counter-terrorism (ICT) database includes some 167 terrorist incidents involving a nuclear target for the period 1970 – 1999. Between 1966 and 1977 there were 10 terrorist incidents against European nuclear installations (reactors plus other types of nuclear facility). Between 1969 and 1975 there were 240 bombing threats against US nuclear facilities, and 14 actual and attempted bombings. According to a Russian intelligence official, during the years 1995-1997 there were 50 instances of nuclear blackmail in Russia. Most of them were hoaxes. The most dangerous trend in these years, according to this source, is the so-called motiveless acts of terror, in which the criminals put forward no political or financial demands. In such cases there is nothing to negotiate. [1]

(1) **3rd May 1975** An attack by the Meinhof-Puig-Antich Group with dynamite at the construction site of the Fessenheim Nuclear Power reactor station, 45 miles south of Strasbourg, France. No nuclear material was in stock or service at the site. A Le Monde correspondent at Strasbourg reported that the perpetrators of the bombing seemed to know the site and understand the features of a nuclear power station. Two bombs had been placed in the centre of the plant next to a nuclear reactor. [2]

(2) **December 1977** Four Basque separatists detonated bombs on the construction site of the Lemoniz reactor in Spain. The reactor pressure vessel and a steam generator were damaged and two workers killed. [3]

(3) **November 1979**. A bomb damaged a transformer at the Goesgen reactor in Switzerland just after it had gone into operation. [4]

(4) **In 1982** five rockets were fired into the French Creys-Malville nuclear facility, but the damage was minor. [5]

(5) **22nd December 1982** The African National Congress (ANC) bombed South Africa's Koeberg-1 reactor in retaliation for a South African Defence Force raid on Maseru, Lesotho, in which 42 ANC members and Lesotho citizens were killed. The damage caused by a series of four explosions to the R1.8 billion complex was reportedly extensive. [6]

(6) **June 1985**. An act of sabotage carried out against the first Philippine nuclear power plant by Communist guerrilla fighters who exploded 26 electricity pylons in two weeks. [7]

(7) **In March 2000** police in New Zealand uncovered a possible plot to blow up a nuclear reactor in Sydney during the Olympic Games. In the course of an investigation into organized crime syndicates the Auckland police conducted a series of house raids in the city and found evidence suggesting a plan to attack the Lucas Heights nuclear reactor near Sydney, Australia. [8]

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## Annexe 2 Past Shipments of High Level Nuclear Waste and plutonium

| Year | Ship | Route | No. glass blocks | Transport flasks |
|---|---|---|---|---|
| 1995 | Pintail | Cape Horn | 28 | 1 cask |
| 1997 | Teal | South Africa | 40 | 2 casks |
| 1998 | Swan | Caribbean | 60 | 3 casks |
| Early 1999 | Swan | Caribbean | 40 | 2 casks |
| 1999-2000 | Swan | Caribbean | 104 | 4 casks |
| 2000-2001 | Swan | Cape Horn | 192 | 8 casks |
| 2001-2 | Sandpiper | Caribbean | 152 | 6 casks |
| 2003 | Swan | Caribbean | 144 | 6 casks |
| 2004 | Sandpiper | Caribbean | 132 | 5 casks |
| 2005 | Sandpiper | South Africa | 124 | 5 casks |
| 2006 | Sandpiper | Caribbean | 164 | 7 casks |

See for example "11th Vitrified waste shipment to Japan" 30th Jan 2006
http://www.cogema.com/servlet/ContentServer?pagename=cogema_en/communique/communique_full_template&c=communique&cid=1132047413064&p=1039482707194

| Year | Ships | Route | Pu | MOX | Made by | Delivered to |
|---|---|---|---|---|---|---|
| 1992 | Akatsuki-maru | South Africa | 1.7 tonnes of Pu Oxide | | | Japan |
| 1999 | Pacific Teal | South Africa | 221 kg Pu | 32 fuel elements | Cogema/ Belgonucleaire | TEPCO – Fukushima 1 |
| 1999 [same time as above] | Pacific Pintail | South Africa | 225 kg Pu | 8 fuel elements | BNFL | Kansai – Takahama |
| 2001 | Pintail/Teal | South Africa | 220 kg Pu | 28 fuel elements | Cogema/ Belgonucleaire | TEPCO Kashiwazaki-Kariwa-3 |
| 2002 | Pintail/Teal | South Africa | 225 kg Pu | 8 fuel elements | Kansai – returning faulty BNFL MOX received in 1999 | Sellafield |
| 2004 | Pintail/Teal | Atlantic | 140kg Weapons-grade plutonium | | US Military | Cadarache, France |
| 2005 | Pintail/Teal | Atlantic | Mox containing 140kg weapons-grade plutonium | | Cadarache, France | Charleston, South Carolina |