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The potential for terrorist strikes on nuclear facilities

Introduction

Governments have known since the 1990's that terrorists have regarded nuclear power plants as potential targets. Since intelligence reports that the fourth hijacked plane involved in the September 11th attacks on the United States may have been heading for the nuclear plant at Three Mile Island in Pennsylvania, this concern has increased. The UK Office of Civil Nuclear Security (part of the Department of Trade and Industry) have now had to admit that nuclear power plants are possible terrorist targets. The most likely scenarios for an attack range from insider sabotage or theft of nuclear materials to outside invasion or assault on a nuclear reactor or waste store.

Overall, the nuclear industry defends its plants against natural and accidental incidents on the basis of 'as chance would have it' and it provides protection against human error by designing the systems and equipment to be tolerant and/or independent of human action (or inaction). This approach may have some effect in safeguarding the plant against accidents and unintentional human error but it could prove woefully ineffective against intentional and intelligently driven acts of terrorism.

The target of the attacks

The most likely targets of a terrorist attack might be considered to be the reactor itself, however attacks on nuclear storage facilities, such as those for "spent" nuclear fuel may be more catastrophic.

Many of the UK's nuclear plants were designed in the 1950's and 60's. Despite nuclear industry claims about the integrity of its buildings none of the building designs ever considered or accounted for anything more than an accidental strike by a light aircraft.

In the aftermath of September 11th, the International Atomic Energy Agency (IAEA) stated that whilst the reactor buildings were built to withstand impacts this did not include wide-bodied passenger jets full of aviation fuel. The US Nuclear Control Institute (USNCI) concluded that a direct hit by a large commercial passenger jet would have a high likelihood of penetrating a containment building that houses a nuclear reactor.

Other buildings used for storage of spent nuclear fuel for reprocessing are also vulnerable. On average spent fuel pools contain five times as much radioactive material as the reactor core, and are often housed in simple steel buildings even more vulnerable to attack than the reactor containment building itself. Cogema who run the La Hague nuclear reprocessing plant on the north coast of France admitted that the plant was only designed to withstand the impact of an aircraft weighing less than 6 tonnes. The Boeing 767 aircraft used in the US terrorist attacks weighed around 180 tonnes. Similar buildings house similar materials at Sellafield in Cumbria.

Effects of attacks

One of the most serious attacks could occur on the buildings housing nuclear reactors. Containment buildings are designed to withstand strong impacts, however a simple breach in the integrity of the structure by an aircraft laden with aviation fuel could cause a major release of radioactivity. In 1982, a study by the Argonne National Laboratory of the US Department of Energy, found that if a jet aircraft crashed into the containment building protecting the nuclear reactor and only 1% of its fuel ignited after impact, the

resulting explosion could compromise the integrity of the containment building, causing a huge fire, a failure of the operating function around the reactor, and a major release of radioactive material.

Dr Frank Barnaby of the Oxford Research Group concluded that the high-level waste tanks at Sellafield and La Hague contain a huge amount of radioactivity and are less well-protected than reactors. The effect of an attack on spent fuel ponds at Sellafield could be just as catastrophic. An attack could cause the irradiated fuel to catch fire, particularly if the aircraft's fuel is already on fire. The World Information Service on Energy in Paris stated that nuclear storage tanks at Sellafield could spray up to two tonnes of deadly caesium-137 into the atmosphere if struck by a hijacked jumbo jet compared with the 50lb of caesium released during the Chernobyl reactor blast in 1986. A successful attack on Sellafield could lead to the deaths of hundreds of thousands of people and leave large areas of Britain uninhabitable for decades.

On the other hand the objective of the terrorist groups may be to remove suitable radioactive materials to construct their own nuclear devices.

Plutonium is also extremely radiotoxic, and inhaling just 80 micrograms of plutonium is usually fatal. The reprocessing of nuclear fuel at Sellafield in the UK has created the largest mountain of non-military plutonium in the world.

A study prepared for the USNCI concluded that a terrorist group could make a useable nuclear bomb from stolen plutonium or highly enriched uranium. Hundreds of tons of plutonium are stored and transferred around the world between nuclear installations. Only around 18 pounds of plutonium or 55 pounds of highly enriched uranium are sufficient to make a nuclear bomb.

Nuclear material often goes "missing" at UK nuclear installations. This is often explained away as "accounting errors". IAEA security standards on nuclear materials tend to concentrate on international shipments and not on the nuclear installations. Since 1993 the IAEA has reported 175 cases of nuclear trafficking, 18 involving highly enriched uranium or plutonium suitable for use in nuclear weapons. Al-Qaeda has attempted to buy weapons grade nuclear materials in South Africa and Asia and a leading Pakistani nuclear engineer made repeated visits to the Taliban stronghold of Kandahar between 1998 and 2001.

A serious threat?

For some 12 years now, America has deemed the threat of a terrorist attack on a nuclear power station to be serious enough to identify specific types of threat and test their ability to respond to them by so-called 'force en force trials'. These threats – called Design Basis Threats (DBTs) – only cover very few of the possible eventualities, but the fact that the US authorities even attempt to address them puts the Americans far ahead of our own nuclear security arrangements.

The three main Design Basis Threats are:

- **The Farmer Brown scenario**. This essentially considers what could be done to negate an attack from an aggrieved individual who has decided to attack a power plant alone with some form of light weaponry or explosives, either by entering the plant as a visitor or attacking from outside the plant with a vehicle bomb. This is entirely plausible, as attacks like the Oklahoma bombing in 1995 demonstrate, and are extremely difficult to respond to due to the unpredictability of the attacker. There

are various parts of a nuclear site that would be susceptible to explosives, such as the control room, fuel storage areas and radioactive waste stores.

- **Passive/Active Insider scenario**. This involves either an insider sabotaging the safety systems from the inside – which describes the active insider – or possibly providing sensitive information for a group of attackers to maximise the impact of their attack – the passive insider. Such scenarios have some historical precedent, such as the incident at the SR1 Reactor in Los Alamos in 1962 where one of the engineers is believed to have deliberately pulled out the only control rod.(1)

- **Armed Insurgent Attack.** This describes a group of organised, lightly armed and informed individuals attacking the site in a premeditated manner. Their aim is to gain access to the most sensitive parts of the site where the maximum amount of damage could be caused. In South Africa, the ANC attacked and disabled one of the Koeberg PWR reactors as it was nearing final commissioning.

The US NRC has conducted over 90 force en force trials (coined as 'Operational Safeguards Response Evaluation Tests') but despite the fact that the security staff receive prior warning of the tests, about 45% of the tested nuclear plants failed. Most disturbing is that three plants tested shortly before September 11th (Farley, Oyster Creek and Vermont Yankee) were the worst on record. In another assessment, The NRC notes that between 15-20% of US nuclear plants would sustain safety critical levels of damage from a vehicle bomb accessing close to the supervised boundary of the plant. (2)

The British response to design basis threats

The truly alarming fact is that the UK simply does not incorporate a requirement for its nuclear power stations and plants to be tested against what are now considered to be credible acts of terrorism. Nuclear safety and the emergency planning legislation do not take account of terrorism in any detail whatsoever. (3)

In fact, unlike the United States where DBTs are assumed to be real, physical attacks on the power stations, the UK relies upon detecting the terrorist intent in good time to be able to avert the attack, rather than requiring the operator to physically modify and strengthen the plant. This effectively means that there are no security measures that would adequately negate the damage of a deliberate attack other than catching any would be terrorists before they find themselves in a position to inflict harm. This approach therefore relies almost entirely on the effectiveness of our intelligence services, leaving absolutely no room for error whatsoever.

Even though the United States force-on-force approach is seriously deficient in many areas, at least the US is realistic about the prospect of deliberate attacks on civil nuclear installations and, with this recognition, endeavouring to logistically evaluate how the damage of such an attack might be minimised. Meanwhile, we in the UK are clinging on to the extremely precarious assumption that we will identify and stop any potential attackers well before they get in range of their target.

Examples of UK blundering in the nuclear security area

The effectiveness of nuclear power station plant security and emergency planning is illustrated by the following examples:

- During the course of a recent full scale exercise at Bradwell nuclear power station with a simulated radioiodine release, the emergency response arrangements were shown to be woefully inadequate in several important respects. Amongst the

shortcomings of what was essentially a table top exercise, at notification of the incident there was no information provided on the type of incident, wind direction, or wind speed. When the messaging systems were established, some confusion arose as to which nuclear power was actually involved in the incident, with one message being interpreted to mean that the incident was at Sizewell and not, as it was supposed to be, at Bradwell. The system advising on countermeasure implementation was not clear as to whether a particular countermeasure was being advised for implementation or if it had actually been implemented and, to make matters worse, the messaging was displayed in white on the computer VDUs so that when printed it produced blank sheets of paper. Also, even though the decision to distribute potassium iodate tablets was taken one hour following the declaration of a radiation emergency, access to the potassium iodate tablets for public distribution was not available until almost eight hours from the start of the release, by which time a considerable thyroid uptake of radioiodine would undoubtedly have occurred. (4)

- In dealing with the aftermath of a terrorist attack the three emergency services have entirely different approaches to radiological management and radiation dose limitation. The fire brigades have a national agreement that limits individual firefighters and teams of firefighters to a maximum single incident dose and they are trained in radiation procedures, fully equipped with personal dosimeters and have protective clothing and breathing apparatus. In comparison, ambulance personnel, paramedics and general hospital A&E staff have a zero-tolerance to radiation dose, no specific training and personal dosimetry, although some hospitals have contamination suits which can be used for 20 minutes maximum. The police, who are to control the public movement and secure areas, have no radiation procedure training, no personal dosimetry and will not be equipped with radiation protection clothing. This situation could result in absolute chaos in the aftermath of any incident.

- Just before the anniversary of the 11th September attack, a reporter from the News of the World used false references to gain a job as a Fire Watcher at British Energy's Dungeness B power station (5). He was allowed to walk close to the reactor and study detailed plans of the site. Security breaches like this, with the aftermath of 11th September still very much in the minds of the public, indicate just how lax so much of the existing security has become.

- Just one month after the above incident, 140 Greenpeace volunteers walked straight in to another British Energy power station at Sizewell B in Suffolk using nothing more sophisticated than a step ladder and a piece of carpet. Protestors occupied the roof of one of the site buildings for over 24 hours. Three months later, a further 40 Greenpeace volunteers returned to try and break in again in the hope that security had been improved. It had not. 11 people got inside the control building and a further 9 climbed up on to the reactor dome. They used nothing more sophisticated than a set of wire cutters and a ladder.

Complacency

Energy Minister Brian Wilson has confirmed that security at UK nuclear sites is being reviewed but he was unable to divulge specific details for reasons of confidentiality. However anti-terrorist security checks by OCNS had taken place at only 9 of the 31 nuclear installations during 2001 and they admitted that there is a shortage of suitably qualified inspectors. (6)

Many of the UK's nuclear plants were designed in the 1950s, 60s and 70s with the safety reasoning based on the likelihood of accidents occurring. If, on a probabilistic basis, the chance of a severe accident occurring was considered to be acceptably infrequent then there was no requirement for the plant to cater for that accident (7). However, probabilistic reasoning can only apply to natural and accidental events, whereas terrorist acts have to be considered as eventualities, free of chance or the unlikelihood of occurrence. In effect, the whole basis of setting the nuclear safety case and, hence, the physical design of United Kingdom nuclear plants on the basis of probabilistic risk assessment (PRA) is, now that there is a continuing terrorist threat, completely invalidated.

It is not obvious what substantive measures have been taken to counter these new threats. It is each nuclear sites own responsibility to deal with security matters, and it is doubtful if they have the personnel, resources and training to deal with a terrorist attack from land or air. British Nuclear Fuels continues to insist that containment building and storage facilities are constructed to "highly robust engineering standards" and "resistant" to many terrorist threats, despite evidence to the contrary.

In France the government has placed ground-to-air missiles near the nuclear reprocessing plant at La Hague and in the US, nuclear power plants failed to repel mock terrorist attacks conducted by the Nuclear Regulatory Commission during the 1990s.

It is clear that a culture of complacency exists within the nuclear industry and government despite international terrorism being a force to be reckoned with. Nuclear power stations and their radioactive wastes are one such means that could be adopted by terrorists. Closing down the UK's nuclear power stations would deny terrorists one means of potentially devastating attack.

(1) *Final Report of the SL-1 Board of Investigation*, C A Nelson, United Sates Atomic Energy Commission, September 1962

(2) Terrorism Threat and Nuclear Power: Recent Developments and Lessons to be Learned, Lyman E, Rethinking Nuclear Energy and Democracy after 09/11, Int Symp, PSR/IPPNW Switzerland, Basel April 2002

(3) The Nuclear Installations Act 1965 and the *Radiation (Emergency Preparedness & Public Information) Regulations*

(4) *Bradwell Level 3 Exercise* of 10 May 2002, BNFL Emergency Planning Services, Final Report, September 2002

(5) Irish Examiner 09 September 2002

(6) 1st Annual Report of the Office of Civil Nuclear Security, June 2002

(7) *Safety Assessment Principles for Nuclear Plants*, NII, Health & Safety Executive, May 2000 first introduced for nuclear reactors in 1979 and for nuclear chemical plants in 1983 – see also *The Tolerability of Risk*, Health & Safety Executive 1988, revised 1992 – essentially, this considers that if the chance of accident is less than one in a million then the accident is unlikely to occur (ie it is an incredible event) and thus there is no need to provided countermeasures against it – for example, for the Sizewell B nuclear safety case it was considered the chance of a commercial jet-airliner crashing on a nuclear critical part of the plant was one in 70 million, so there was no need to plan for this event.