Q&A on Nuclear Safety

(1)There have only been two major accidents in civil nuclear stations – Three Mile Island and Chernobyl – after more than 12,000 reactor years. The first one was contained without harm, and the second only killed around 56 people. That's a pretty good record isn't it?
http://www.world-nuclear.org/info/inf06.html

The Union of Concerned Scientists (UCS) described the profile of risk over the lifetime of a reactor as a 'bathtub' curve. New reactors start out as a high-risk as they are 'broken-in'. In the middle of their life, reactors should be in peak health where the risks are at their lowest. Then as reactors get older they enter a 'wear-out' phase with a high risk that components will wear out and fail. [1]

Literally thousands of unexpected safety problems have surfaced at new reactors, and there are several examples of disasters, which happened during the 'break-in' phase – Fermi, Three Mile Island and Chernobyl are three examples. At the start of 2005 there were 441 nuclear power reactors, operating in 31 countries. Of these, over 300 were more than 20 years old. Clearly, as with any other sort of equipment, as reactors get older there is an increased risk of age-related failures. So, it is possible that we may see more accidents as the world's inventory of nuclear reactors gets older. All the more worrying then that across the globe there is a general trend towards extending the life of reactors.

The Three Mile Island Unit II reactor core suffered a partial meltdown and released more than 10 million curies of radioactivity into the atmosphere. There is no safe level of radiation exposure; every increment of exposure will lead to a proportional increase in the risk of cancer. So it is misleading to say that the accident caused no harm. There will have been an increase in cancers as a result of the accident, but sufferers will not be identifiable. [2] Nearly 150,000 people left their homes near the facility and did not return until the situation stabilized days later.

We were relatively lucky at TMI because the plant was minutes away from the molten reactor core burning its way through the reactor vessel and triggering a steam explosion that would have released massive amounts of radioactivity into the atmosphere. We may not be so fortunate next time. [3] Following the 1979 accident, Sandia National Laboratory carried out a study on the public health and environmental impact of a core damage accident with containment failure. [4] This assessment assumes that reactor core damage has occurred and that radioactive material has been released to the environment. For each nuclear plant then in operation and nearing completion, Sandia determined the amount of radiation that could be released following a major accident, the area's weather conditions, and the population downwind of the plant. Then Sandia estimated how many Americans would die and be injured within the first year due to their radiation exposure. Early fatalities were up to 100,000 people, with as many as 40,000 cancer deaths. [5]

The idea promoted by the nuclear industry that the Chernobyl accident has only resulted in a small number of deaths is now completely without any credibility. Even the International Atomic Energy Authority's (IAEA) Chernobyl Forum has predicted 4,000 cancer deaths in total. A report by two UK radiation scientists for the European Green Party [6] says that Chernobyl could kill up to 60,000 people - 15 times as many as officially estimated. The scientists accuse two UN organisations, the International Atomic Energy Agency (IAEA) and the World Health Organization (WHO), of downplaying the impact of the accident. Zhanat Carr, a radiation scientist with the WHO in Geneva, says an extra 5000 deaths were omitted from an IAEA/WHO report because it was a "political communication tool". Elizabeth Cardis, a radiation specialist from the WHO's International Agency for Research on Cancer in Lyon, France, says that 30,000 to 60,000 cancer deaths is "the right order of magnitude". [7]

A Greenpeace report, which involved work by 52 respected scientists and includes information never before published in English, shows that the full consequences of the Chernobyl disaster could top a quarter of a million cancers cases and nearly 100,000 fatal cancers. The report also looks into the ongoing health impacts

of Chernobyl and concludes that radiation from the disaster has had a devastating effect on survivors; damaging immune and endocrine systems, leading to accelerated ageing, cardiovascular and blood illnesses, psychological illnesses, chromosomal aberrations and an increase in foetal deformations. [8]

(2) The risks from western nuclear power plants, in terms of the consequences of an accident or terrorist attack, are minimal compared with other commonly accepted risks aren't they?

A major study of reactor hazards by two leading scientists and an international energy specialist, published by Greenpeace in April 2005, concluded that risks from reactors in the West have been significantly increasing over the last few years and the likelihood of accidents occurring is now higher than ever. [9] The authors argue that all operational nuclear reactors have very serious inherent safety flaws, which cannot be eliminated by safety upgrading, and a major accident in a reactor today could be far more severe than Chernobyl, the world's worst nuclear accident, which took place on 26th April 1986.

(3) Every year several thousand people die in coal mines. By comparison nuclear power is extremely safe isn't it? And the use of fossil fuels has significant health and environmental effects doesn't it?

The potential release of a large amount of radiation contaminating a vast area represents a unique vulnerability of nuclear power. The impacts on human health and the environment, the difficulty and cost involved in cleanup and decontamination efforts and the long time-scales of the impacts of the contamination all make the large-scale release of radiation from a nuclear plant a truly unique concern. There are also unique risks associated with nuclear waste management. Depending on the management route chosen, some types of accidents can lead to the same kind of long-term contamination of vast areas. In addition to accidents, the possibility of terrorism or intentional acts of sabotage adds to the uncertainty of any risk estimates.

The way that the nuclear industry often compares different types of risk is based on a flawed logic. For example, in October 1975 the US Nuclear Regulatory Commission issued the Rasmussen report – also known as WASH-1400 or the Reactor Safety Study. The executive summary of this report presented the now infamous figures purporting to show that the risks from living near a nuclear plant were less than being struck by a meteorite. It predicted that an accident like Three Mile Island would occur just once every 100,000 years. [10] By 1999 reactor operating experience in the US amounted to around 2,400 reactor years. So, in reality there is one accident every 2,400 years. [11]

We shouldn't be comparing nuclear with coal – at least not large centralised coal-fired generating stations. Coal will need to be phased out as quickly as possible in any case. [12]

(4) Passively safe reactor designs may have less safety systems, but the passive safety systems they do have cut out the need for operator intervention. Doesn't this help remove the danger of accidents through human error?

About twenty different new reactor designs are reported to be under development. Most are "evolutionary" designs developed from existing reactor types. Many of these new designs - so-called 'passive' safety systems - rely on a completely different safety philosophy.

Existing reactor designs rely on two important nuclear safety principles: redundancy and diversity. Redundancy requires having more than one item to do the same thing so that if one fails there is a backup. Diversity requires having more than one way of doing the same thing so that if there is a generic failure that applies to all of the same type of equipment, then there is also back up for that. The passive safety concept does not adhere to the redundancy and diversity principles. Instead it relies on gravity and convection, or so-called "passive" safety systems. It is true passive systems attempt to avoid relying on nuclear operators to deal with emergency situations, but there is a trade-off. If an emergency event has not been predicted by designers and requires intelligent intervention operators may be left with no means to do anything about it. In addition some of the designs may be even more vulnerable to terrorist attack than conventional designs. [13]

(5) Industry's analyses and the fact that Three Mile Island, despite melting down, did not cause any harm show that we don't need to be overly concerned don't they?

The impact of an accident on human health is not the only thing we need to worry about. If we are going to be successful in our battle against climate change we need to make very large reductions in the amount of carbon emissions we are making into the atmosphere. For example, the UK Government is committed to a 60% reduction by 2050. Even then, some believe this may not be enough. [14] Either way this means that we need to start making reductions now. Delaying action will require much more drastic and less manageable cuts. If we put all our effort into getting a new reactor building programme off the ground it could be as late as 2020 before any new reactors start operating.

The partial core meltdown at Three Mile Island in 1979 and the steam explosion at Chernobyl in 1986 demonstrate that an accident in any country can affect the acceptance of nuclear plants around the world. So an accident between now and 2020 could halt any plans for new reactors and seriously damage any prospect of the limited reductions in carbon emissions which may have been possible.

An accident would also have a serious economic consequences. As Peter Bradford, a former Nuclear Regulatory Commissioner has pointed out:-

"The abiding lesson that Three Mile Island taught Wall Street was that a group of NRC-licensed reactor operators, as good as any others, could turn a $2 billion asset into a £1 billion cleanup job in about 90 minutes." [15]

Added to the financial losses accompanying the destruction of a reactor are the costs of purchasing replacement power. Other costs would be incurred for relocating populations, and the costs associated with the contamination of buildings, land, food crops, water and other types of property. In 1981 Sandia National Laboratory estimated the potential financial costs of an accident. The top 20 worst case reactor accidents were estimated to cost between $255 billion and $657 billion. [16]

[1] Watch video footage of David Lochbaum of the Union of Concerned Scientists discussing nuclear safety at:
http://www.youtube.com/watch?v=Y5z1TZfntiY
[2] BEIR VII (Biological Effects of Ionizing Radiation) report quoted in Smith, B "Insurmountable Risks", IEER 2006, page 189.
http://www.no2nuclearpower.org.uk/reviews/index.php
[3] Three Mile Island's Puzzling Legacy, 1999,
http://www.ucsusa.org/clean_energy/nuclear_safety/three-mile-islands-puzzling-legacy.html
[4] Jim Riccio, Risky Business: The probability and consequences of a nuclear accident, Greenpeace USA, 2001.
http://www.greenpeace.org/raw/content/usa/press/reports/risky-business-the-probabilit.pdf
[5] David Lochbaum, Nuclear Plant Risk Studies: Failing the Grade Union of Concerned Scientist, August 2000.
http://www.ucsusa.org/assets/documents/clean_energy/nuc_risk.pdf
[6] Ian Fairlie and David Sumner, The Other Report on Chernobyl (TORCH) European Greens 6th April 2006
http://www.greens-efa.org/cms/topics/dokbin/118/118499.the_other_report_on_chernobyl_torch@en.pdf
[7] New Scientist 6th April 2006
http://www.newscientist.com/article/mg19025464.400-how-many-more-lives-will-chernobyl-claim.html
[8] Greenpeace International 18th April 2006
http://www.greenpeace.org/international/news/chernobyl-deaths-180406
The Chernobyl Catastrophe: Consequences On Human Health, Greenpeace International April 2006.
http://www.greenpeace.org/raw/content/international/press/reports/chernobylhealthreport.pdf
[9] Helmut Hirsch, Oda Becker, Mycle Schneider and Anthony Froggatt, Nuclear Reactor Hazards: Ongoing Dangers of Operating Nuclear Technology in the 21st Century, Greenpeace International, April 2005.
http://www.greenpeace.org/raw/content/international/press/reports/nuclearreactorhazards.pdf
[10] Smith, B "Insurmountable Risks", IEER 2006, section 4.3.1
http://www.no2nuclearpower.org.uk/reviews/index.php
[11] as [3]
http://www.ucsusa.org/clean_energy/nuclear_safety/three-mile-islands-puzzling-legacy.html
[12] Nuclear power: economics and climate protection potential by Amory Lovins, Rocky Mountain Institute, Updated 6th January 2006.
http://www.rmi.org/images/other/Energy/E05-14_NukePwrEcon.pdf
See also Mighty Mice, by Amory Lovins, Nuclear Engineering International 21st December 2005

http://www.neimagazine.com/story.asp?sectionCode=188&storyCode=2033302
[13] WISE News Communique, 22nd May 1998 http://www10.antenna.nl/wise/492/4881.html
Cummins, Corletti and Schultz, Westinghouse AP1000, Advanced Passive Plant, Proceeding of ICAPP 03.
http://www.nuclearinfo.net/twiki/pub/Nuclearpower/WebHomeCostOfNuclearPower/AP1000Reactor.pdf
Westinghouse website: http://www.westinghousenuclear.com/AP1000/index.shtm
[14] See for example The Future Starts Here: The route to a low carbon economy. A report by the Tyndall Centre for Climate Change Research for FoE and the Co-operative Bank, Sept 2006.
http://www.foe.co.uk/resource/reports/low_carbon_economy.pdf
[15] Quoted in [10] pages 192 & 298
[16] Ref [10] page 194