Is Nuclear Power Safe?

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The author, a Chartered Engineer, worked as HM Inspector of Health and Safety in mining and quarrying for 25 years. His timely new pamphlet, from which this excerpt is taken, is entitled Nuclear Reactors: Do We Need More? *(Spokesman Books, £2.50 post included).*

More than 400 nuclear reactors operate worldwide. The serious incidents that occurred at Windscale in 1957, at Three Mile Island in 1979, and at Chernobyl in 1986 are well known. Other incidents, especially those that occurred during the Cold War, were not then made known to the public. Some remain to be described. Others such as the releases from the Hanford site in Washington State where eight reactors were built to produce military plutonium between 1943 and 1971 have been disclosed in the United States using Freedom of Information Act provisions. In February 1986, 19,000 pages of documents were released on the application of the Hanford Education Action League. They learned that clouds of radioactive iodine, ruthenium, caesium and other elements were released into the atmosphere contaminating people, animals, water and crops for hundreds of miles. Between 1944 and 1956, 530,000 curies of radioactive iodine was released. The Colombia River became grossly contaminated. In 1954, with six reactors on line, 8,000 curies of radioactive material was dumped into the river each day. By comparison, the radioactivity released at Three Mile Island was 15-24 curies of radioactive iodine. From Chernobyl 3 million curies of caesium 137 was released – a total comparable with the fallout from all nuclear weapons tests to date. The estimate of all radionuclides released from Chernobyl is 50 million curies.

During the Sizewell Public Inquiry it was argued that human factors, not least human error, had been neglected in the Central Electricity Generating Board's estimates of reactor safety. After the completion of the Inquiry, but before the Inspector appointed to conduct the inquiry, Sir Frank Layfield, had written his report, the Chernobyl explosion occurred, and the early accounts of what had happened left no doubt that human error, notably the defeat by management of the built-in safety systems, was one of the causes. Sir Frank Layfield in his report recommended that there should be further study

of human factors by the Central Electricity Generating Board and by the Health and Safety Executive (HSE). The study by the Health and Safety Executive was multidisciplinary and involved all the inspectorates and the research division. In my contribution to the HSE study, I stated that what one most needed to know about human error was that one could depend on it. That conclusion was not disputed by my colleagues, but it did not feature strongly in the evidence submitted to the Hinkley Point 'C' Public Inquiry by the Director General of the Health and Safety Executive, Mr J D Rimington. The report, *The Tolerability of Risk from Nuclear Power Stations,* appended to his evidence, modified the probabilistic risk assessment of a major reactor failure of one per million years of reactor operation to one in 100,000 years to take account of human error. My evidence to that inquiry included the following.

> 'The probabilistic risk assessment was based on guesses about human factors by people who had no experience of power station management.
> That comparisons of risk with other methods of electricity generation were not made as required by the Health and Safety at Work etc Act.
> That the problems of regulating the industry in private ownership were underestimated, and
> That major qualitative differences of risk were ignored, e.g., that not all risk takers would be beneficiaries and that waste management problems would remain for longer than civilisation has existed.'

Fortunately, no failure similar to Chernobyl has yet occurred. The estimates of the consequences of the Chernobyl explosions vary widely from 31 proven deaths by A. Gonzales of the UN International Atomic Energy Agency (IAEA) to nine million people affected – an estimate accepted by Kofi Annan, Secretary General of the United Nations. Estimates of future deaths vary from 40,000 (a contemporary Soviet estimate) to 400,000 by a former Manhattan Project scientist – an estimate based on a correlation of radionuclide release and fatal cancers. Which fatal cancer can be attributed to exposure to which radionuclide is a question for which answers are rare. The Russian Academy of Medical Sciences declared that 212,000 people have now died as a direct consequence of Chernobyl.

The town of Pripyat remains uninhabited. One hundred and twenty thousand people were eventually evacuated from the exclusion zone round the plant.

Mikhail Gorbachev became leader of the Soviet Union on 11 March 1985 when he was elected General Secretary of the Communist Party. By November of that year he had met the US President Ronald Reagan and started the negotiations that led to the largest reduction in the world's nuclear weapons ever negotiated. Five months later, the Chernobyl No 4 reactor exploded. In his memoirs he wrote:

> 'Neither the politicians, nor even the scientists and specialists, were prepared to fully grasp what had happened.
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> The closed nature and secrecy of the nuclear power industry, which was burdened by bureaucracy and monopoly in science, had an extremely bad effect. I spoke of this at a meeting of the Politburo on 3 July 1986: "For thirty years you scientists, specialists and ministers have been telling us that everything was safe. And you think that we will look

> on you as gods. But now we have ended up with a fiasco. The ministers and scientific centres have been working outside of any controls. Throughout the entire system there has reigned a spirit of servility, fawning, clannishness and persecution of independent thinkers, window dressing, and personal and clan ties between leaders."
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> The Cold War and the mutual secrecy of the two military alliances had also been a factor. There had been 151 significant radiation leaks at nuclear power stations throughout the world, but almost nothing was known about them or their consequences. Academician V A Legasov said that the likelihood of nuclear accidents was believed to be very small, and that science and technology throughout the world were not particularly prepared for them. Complacency and even flippancy ruled. I still recall what Academician A P Aleksandrov and Ye P Slavsky told the Politburo immediately after the accident. These men had stood at the heart of our nuclear power industry and were its creators – people who were honoured and respected. But what we heard from them were arguments like this; "Nothing terrible has occurred. These things happen at nuclear reactors ..."'

The effects in Britain 20 years after the explosion require the monitoring of sheep reared on 359 upland farms in Wales where rainfall increased the Chernobyl fallout. If when ready for slaughter the animals have radioactivity levels higher than 1000Bq per kilogram (one Becquerel is one atomic disintegration per second) they are deemed unfit for human consumption and the farmer can be compensated. Farmers mitigate the effects by moving the animals to lower pasture or more distant sites where the grazing is less contaminated and where the animals' radioactivity levels can be gradually reduced to below 1000Bq/kg.

It is not only farm animals that eat vegetation grown on contaminated land. All forms of plant and animal life and water supplies can be affected. The effects are not confined to one generation suffering cancers and reduced immunity to other diseases. Exposed persons and their children and their descendants can suffer mutagenic effects, even teratogenic effects – literally 'monstrous' birth deformities.

The fatalities and the ill health resulting from bomb tests and discharges such as Chernobyl are not as large as those attributable to hydrocarbon extraction and its conversion to electricity or its use in transport. The Chinese mining industry, for example, is reported to have more than 3,000 deaths per year from injuries suffered below ground. Such losses were shown to be avoidable in the UK mining industry which once killed 50,000 miners in 50 years but which, in the 1980s, could produce 100,000,000 tons of coal with good management and better technology and deaths in single figures. Global warming probably caused by human activity could entail even greater losses. Action is required by the precautionary principle.

At a conference attended by World Health Organisation (WHO) and International Atomic Energy Agency personnel and others in Kiev in June 2001, there was concern that the proceedings of a similar conference held in 1995 had not been published. The reason was that the World Health Organisation was allowed to publish material on the effects of ionising radiation only with the agreement of the International Atomic Energy Agency and permission had been

withheld under the terms of an earlier agreement. Neither organisation had been sufficiently represented in studying the health effects of the Chernobyl explosion, and a recurring concern even in 2001 was that data was not being collected and reported in the Ukraine, in Belarus to the north, and in Russia.

In a film of some of the proceedings of the Kiev conference made by Swiss film makers, now published by the UK Low Level Radiation Campaign, some of the disagreements remain all too visible. Agency officials and others are shown arguing with medical practitioners that Chernobyl as a hazardous event is over, that there is nothing that need now cause concern. One argues that there is no difference between exposure to external radiation and exposure from ingested and retained sources of radiation. The manner of dispute by some Agency proponents is revealing to those who may not be expert in the field but who detect arrogance, intolerance and a readiness to denigrate an opponent rather than argue a case. One is left with the impression that the dominant position of the International Atomic Energy Agency *vis-à-vis* the World Health Organisation is not justified and should be ended. One can speculate that having a brief to promote nuclear power has affected the culture of the organisation at the expense of its other commitments.

The film includes scenes of a mother and child. The child born long after Chernobyl has a body mass of 8 kg and a total radioactivity of 10,000Bq. (1250Bq/kg). The explanation for such a level of radioactivity is likely to be the ingestion of radioactive food and water and its incorporation into body tissue where the activity continues as internal emitters. Few people know that in 1990 a Department of Health survey found plutonium in the teeth of every teenage child examined in Britain. The survey of 3,300 adolescents showed minute traces of plutonium in amounts correlating with the distance from Sellafield. When I discussed this finding with my doctor she speculated ‘How did it get there?’.

Low level radiation and internal emitters

Clusters of possibly radiation-related disease near nuclear installations led to public concern and investigation by the Committee on the Medical Aspects of Radiation in the Environment (COMARE). In its Fourth Report (1996) on a tenfold excess of childhood leukaemia in the vicinity of Sellafield the Committee included

> ‘… the current best estimates of radiation doses to the Seascale population is far too small to account for the observed cases of leukaemia and non-Hodgkin’s lymphoma that have occurred in the young people of the village during the period of time studied.’

A similar conclusion had been reached at Dounreay. In rejecting radiation as a cause the Committee was in need of another explanation and suggested a population mixing hypothesis which posits that childhood leukaemia is a rare response to a common but unidentified infection. No biological mechanism was proposed.

There is widespread agreement among scientists that there is no safe level of radiation. Radiation-dose-to-disease relationships based on cancers in survivors of the Hiroshima and Nagasaki bombs are questionable because of the possible

underestimated low level radiation over long periods and dubious control group selection. It seemed to those who suspected that low level radiation from ingested radionuclides was the cause of the Sellafield cluster that rejection on the grounds of low dose did little more than beg the question. There were other objections from those who knew that the extent of illegal discharges into the environment were not known and who envisaged pathways for sea-borne material to return to the atmosphere and to the land.

At Dounreay, again estimating low dose, the COMARE Committee had not been told of the explosion in the Dounreay shaft which discharged unknown quantities of radioactive material over a wide area and their inquiries did not discover it either. One suspects that if they had asked at the nearest pub someone might have told them. The Nuclear Installations Inspectorate had found many irregularities at the plant, even that the licensee, the United Kingdom Atomic Energy Authority, was not in control and lacked expertise and funds after 36 years of virtual self-regulation. The management and monitoring of stored waste was inadequate. The monitoring of personnel was so lax that employees could choose to leave controlled areas without checks and could have taken contamination to their homes.

After consulting the Committee on the Medical Aspects of Radiation in the Environment, the then Environment Minister, Rt Hon Michael Meacher, MP, announced that a working group would be set up with the remit

> 'to consider present risk models for radiation and health that apply to exposure to radiation from internal radionuclides in the light of recent studies and to identify any further research that may be needed.'

Michael Meacher added that

> 'the Committee's review takes account of the views of all parties in the debate on the risks of radiation. It aims to reach agreement where possible. On topics where differences of view remain after its deliberations it will explain the reasons for these and recommend research to try to resolve them. The Committee Examining Radiation Risks from Internal Emitters (CERRIE) will produce a report that is agreed by all its members. The report will not be subject to amendment by COMARE, the Department of Health or DEFRA and will be published. COMARE will consider the CERRIE report and advise government on it.'

The committee was unable to agree on many issues; for example, about half of the members believed that the Seascale excesses were not linked to radiation and that the population mixing hypothesis was a possible explanation. The committee failed to achieve its remit and the failure is best explained by the letter of resignation of one of the three members of the secretariat. She said that her work had been altered and distributed to members without reference to her and that she and a third member of the secretariat had been excluded with the effect that there was bias in the work of the committee towards the views of the chairman. She saw no prospect of there being an agreed report.

Although at one stage the committee accepted by a 10 to 1 vote to include what

amounted to a modified minority report, it rejected it when all its members received letters from the Department for Environment, Food and Rural Affairs' lawyers warning of personal legal liability for any mis-statement of fact. The third member of the secretariat agreed that he had been excluded and that the views of some of the members had been excised from the final report. Michael Meacher, who by then had ceased to be the minister, wrote to his successor asking for an explanation. Two members, Chris Busby from Green Audit, and Richard Bramhall from the Low Level Radiation Campaign, produced a minority report with an introduction by Michael Meacher in which he expressed disappointment that on such an issue as the increase in childhood leukaemia across Europe after Chernobyl the Committee Examining Radiation Risks from Internal Emitters had presented only one side.

Both reports contain valuable references and some conclusions. The CERRIE report concedes that some risks have been underestimated by a factor of ten. The adoption of that conclusion alone and the international agreements to ban sea dumping and liquid discharges to the sea will make the continued operation of the Sellafield plant difficult. The minority report argues for revision of risk factors by two orders of magnitude. It cites many papers from Chernobyl affected areas. One by Professor Yuri Bandazhevsky, a pathologist, Rector of the Medical Institute of Gomel, on the ingestion of radio caesium includes

> 'Clinical checks on children between 1996 and 1999 show that at levels greater than 50Bq/kg there are pathological changes in vital organs and systems – cardiovascular, nervous, endocrine, immune, reproductive, digestive excretory and eyes. Caesium concentrations in the placenta reveal a relationship with nervous system defects in the foetus. The health condition of the population is a disaster but being a physician myself I cannot accept it as hopeless. With all my faith in God and life I appeal to anyone who can influence it: do your best to improve the situation. There is nothing more precious on this planet than life. And we should do everything possible to protect it.'

He is the author of over 400 publications, a member of five academies and the holder of five international awards. His critics, one from the International Committee on Radiological Protection, explain the phenomena as psychosomatic effects of radiophobia generated by such publicity as his own. He criticised his government for lack of involvement. In 2001 he was arrested, charged with corruption, which he denies, and sentenced by the military court of the Supreme Court of Belarus to eight years imprisonment. He was adopted by Amnesty International as a prisoner of conscience. The European Parliament awarded him the Passport for Liberty and the European Union called for a review of his trial. Data on caesium 137 effects was not included in the conference record.

Was the Chernobyl explosion nuclear?

At the Hinkley Point 'C' Public Inquiry is was suggested by at least one witness that the Chernobyl explosion was a nuclear explosion. The suggestion was vigorously refuted by the Central Electricity Generating Board. One of the design requirements for the licensing of a reactor in the United Kingdom is that the

containment shall be capable of withstanding the effects of any fault. Safety Assessment Principle 152 requires 'The containment should adequately contain such radioactive matter as may be released into it as a result of any fault in the reactor.' Clearly if nuclear explosions are possible a licence should not be granted. That they were granted suggests that the Nuclear Installations Inspectorate reject the view that nuclear explosion is possible. What then can we make of the information that two nuclear engineer Fellows of the Royal Society and of the Royal Academy of Engineering have recorded their opinion that the Chernobyl explosion was nuclear? It did displace the 2,000 tonne concrete cap from the reactor.

The Secretariat of the Nuclear Free Local Authorities quote Sir John Hill, a former chairman of the Atomic Energy Authority, who wrote in *ATOM,* the Atomic Energy Authority house journal

> 'When the Americans chose graphite moderated water cooled piles for plutonium production they recognised that a failure of the water supply or control system could result in prompt criticality and a *nuclear* explosion such as happened 40 years later at Chernobyl.' (my emphasis).

Jack Harris is a former Central Electricity Generating Board nuclear metallurgist who writes a monthly column in the Journal *Materials World,* one of the journals of the Institute of Materials, Minerals and Mining. An article he wrote in June 2004 makes clear his acceptance of his colleague Ross Hesketh's view that the Chernobyl explosion was a nuclear explosion. Jack Harris, now a university professor, has been a Fellow of the Royal Society (FRS) since 1988. It would be interesting to know how many other Fellows of the Royal Society, Fellows of the Royal Academy of Engineering, nuclear engineers and physicists share the view that our more recently built reactors are capable of blowing themselves to bits. We really ought to know. Perhaps the matter was decided by the Chernobyl experience but was too difficult to contemplate, let alone acknowledge. It could be the best kept nuclear secret since 1986.

The nuclear industry remains uninsurable worldwide. United Kingdom legislation allows the industry to operate with what is obviously inadequate cover and provides for further cover by the government and the taxpayer.