Windscale FAQs

Amended May 2008 - only question 6 has changed

1. What was the Windscale accident?

The accident occurred in the period from the 10^{th} to 11^{th} October 1957 when a fire broke out in a nuclear reactor on the Windscale (now Sellafield) site in west Cumbria. This led to an uncontrolled release of activity to the atmosphere. The resultant plume of radioactivity travelled over much of England and parts of northern Europe.

2. Why did the accident happen?

The reactor, or atomic pile, in which the fire occurred was one of two constructed to produce plutonium for the UK's nuclear weapons programme. Because of its fairly crude design, energy (known as Wigner energy) became stored in the graphite moderator and had to be occasionally released – this was done frequently by a cycle of low and high power levels. On this occasion, because of bad positioning of thermocouple heat detectors, the operative carrying out the operation was unaware that part of the core was becoming very hot and eventually one or more of the fuel cans failed. This led to a graphite fire which raged undetected for more than 40 hours.

3. How was the accident detected and what were the immediate consequences?

The first indication of the fire came from radioactivity filters which had been placed on top of the 120m chimneys. These filters (known as Cockcroft's Folly after Sir John Cockcroft who had them installed as an afterthought) probably averted a catastrophe because they trapped a large proportion of the radioactive particulate material from the fire. Nevertheless, because the pile was air-cooled, the products of the oxidising fuel in the fire were swept up the chimney by the coolant and released to the atmosphere. A mixture of fission products and some other radionuclides, notably polonium-210, were released. Initially on the 10^{th} October there was a light easterly wind at low levels with SW winds above it, but early on the 11^{th} a NW air stream forced the plume southwards. The cloud was detected at Leeds at 9 am on the 11th and in London at 4 pm. Radioactivity was detected in Belgium at 7 pm and Frankfurt at 10pm on the 11^{th} and in Norway on the 15^{th}.

4. What radioactivity was released?

At the time of the accident, the radionuclide identified as being of principal concern was the fission product iodine-131. It was known that iodine concentrated in the thyroid gland and that children's thyroids were more sensitive than adults. Although iodine-131 has a relatively short half life of 8 days, the route of intake by the population by cow's milk was taken seriously and milk ban was instigated. The inventory of radionuclides released (as reassessed in a study in 1984) was dominated by volatile fission products e.g a gas, Xenon-133 (12000 TBq), followed by iodine-131 (740 Bq) and caesium-137 (22TBq), but also an important alpha emitter, polonium-210 (8.8 TBq). In terms of the collective dose to the population, iodine-131 contributed 37%, polonium-210,37% and caesium-137, 15% .

5. What was the effect on workers?
Some of the workers involved in controlling the fire and the clean-up received higher than normal doses. Doses have subsequently been controlled. A study in 2000 of the 470 male employees involved in fighting the fire and the clean-up operations that followed found no measurable effect on their mortality or cancer morbidity. Both of the reactors were moth-balled after the accident. Final dismantling has only recently begun.

6. How were the public protected?
The public were protected by a milk ban, which was instigated at a radioactive iodine concentration of 3700 Bq/litre – this ban, imposed for a few weeks, covered a coastal strip of land from 10 km north of Windscale to around 20 km to the south, a total area of about 500 sq km. The dry deposition of iodine-131 in this area peaked at about 960 kBq/m^2 (cf. deposition after Chernobyl in the same area was about15 kBq/m^2). The milk withheld from sale was poured away into rivers and streams.

7. What were the health effects?
There was no immediate public health effects reported. Long term health effects would be as a result of internal irradiation of tissues such as the thyroid producing an increased risk of cancer. Assuming a linear relationship between dose and cancer incidence, the collective dose in the population which resulted from intake of radionuclides either through the lung or from food can be used as a predictor of long term effects,. The collective dose which has been estimated (2000 man-Sv, of which approximately 800 man-Sv was from ingestion of milk and other food stuffs, 900 man-Sv from inhalation and 300 man-Sv from external radiation) may result in 100-250 extra cancers in the UK in the next 40-50 years. Considering the variations in normal cancer incidence in the UK and the effects of natural background (which includes a component from polonium-210) as well as other carcinogens, these extra cancers will be statistically undetectable.

8. Is there still a risk?
As long as the radioactive materials released remain in the environment, there is a very tiny increased risk to the population. However, most of the fission products, apart from caesium-137 and the very small amount of strontium-89/90 released will have physically decayed and present no ongoing risk. Of the other materials, polonium-210 has a half life of 138 days and has long gone but the very small amount of plutonium-239 released (0.0016TBq) continues to present a risk legacy.

9. Could the same thing happen in a today's nuclear reactors?
The Windscale piles were unique in the UK. Their crude nuclear technology and operation must be viewed in the political context of the Cold War era and the policy of the then Government to quickly build up an independent nuclear deterrent. While the first stations of the magnox reactor programme at Calder Hall and Chapelcross had a dual civil and military function, all other power reactors built in the UK have been for electricity generation. Because of the design and construction of modern reactors and the safety features now built in, a similar accident could not happen. However, the Windscale accident happened because of a faulty design and operator error, as in the Chernobyl accident 29 years later. Safety features which cannot be

overridden, now incorporated into reactor design reduce “human” involvement, which seek to make accidents of this nature extremely unlikely.

10. What lessons about emergency planning were learned from the accident?
One enduring legacy of the accident was the subsequent attention given to emergency planning around nuclear sites. Multi-agency committees were established, including elected members of local councils and all the emergency services. This early example of public consultation endures to this day. Regular exercises are held to test responses to an incident both on and off-site. Arrangements were updated in the light of other events, particularly the accident in the USA at Three Mile Island and the events at Chernobyl. Off-site incident control now rests with the local police force and briefing goes all the way to government.

The Society for Radiological Protection, Administrative Office, PO Box 117, Buckfastleigh, Devon TQ11 0WA, UK Tel: +44 (0)1364 644487 Fax: +44 (0)1364 644492 Email: admin@srp-uk.org Web: http://www.srp-uk.org Registered Charity No. 1122804

5 May 2008