Sellafield – health and environment issues

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There are many reasons for being concerned about reprocessing, which taken together constitute a powerful case for its cessation. It is an uneconomic and unsustainable technology, which increases the risk of nuclear weapons proliferation. Its persistence in the UK seems to be due largely to the inertia of a long historical legacy, combined with fears of the withdrawal of Japanese investment and the loss of jobs at Sellafield.

Other writers are more qualified than I am to discuss these issues in more detail. My comments will be directed towards the question of discharges from reprocessing plants, and Sellafield in particular.

Discharges

Sellafield has been discharging radioactive waste to the Irish Sea and to the atmosphere for nearly fifty years. In terms of the radiation doses to the UK and European populations from radioactive discharges, Sellafield has always been the dominant installation, and continues to be.

Activity discharged from Sellafield can be detected in the North Sea, on the coasts of Ireland, Iceland, Norway and Denmark, and as far away as the Arctic Seas off Greenland. The discharges to sea of caesium-137 and plutonium alpha-activity peaked in the early to mid-1970s; at that time, annual discharges of alpha and beta emitting radionuclides were respectively about a thousand times and a hundred times the activity in current annual discharges. As a result, in the late 1970s, concentrations of caesium-137 and plutonium off the west coast of Denmark were about double those from nuclear weapons fallout[1].

Sellafield has discharged into the Irish Sea about two and a half times the known alpha activity dumped in the Atlantic from 1946 to 1993.[2] About one third of the alpha discharges to the Irish Sea have not been accounted for in the environment so far.[3] The large amounts of substances such as plutonium in Irish Sea sediments, and the possibility of their migration to coastal environments, have been described by Dr Keith Baverstock of the WHO as a 'long-term hazard of largely unknown proportions.'[4]

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[1] Taylor, P J: The interpretation of monitoring results
In: Radiation and Health: the Biological Effects of Low-level exposure to ionizing radiation
Ed. R R Jones and R Southwood. John Wiley & Sons, Chichester, 1987

[2] Inventory of radioactive waste disposals at sea IAEA-TECDOC-1105 (1999) Table IV, page 13.

[3] PJ Kershaw, DC Denoon, DS Woodhead, Journal of Environmental Radioactivity 44 (1999) 191-221

[4] European Conference on Nuclear Safety, Goteborg, Sweden 24-26 June 1997.

Effects of discharges on human health

Study of the survivors of Hiroshima and Nagasaki has clearly shown that exposure to ionising radiation increases the risk of cancer. However, the doses received by the survivors are generally at least a hundred times greater than the doses received from radiation in the environment. Assumptions therefore have to be made about the cancer risk from low doses of radiation. Radiation protection is based on the so-called linear no-threshold model (LNT) — the concept that the risk of cancer from ionising radiation is directly proportional to dose right down to zero. There are dissenters on both sides, some claiming that the LNT overestimates risk, some that it underestimates it. It has to be said that it is probably impossible to prove or disprove this model by epidemiological studies; but there are sound radiobiological reasons for accepting the LNT, and it is endorsed by both NRPB and ICRP.

The impact of radioactive discharges is usually quantified in two ways: (1) by estimating doses to individuals — usually a **critical group**, defined as a small group of people who, because of their habits or their lifestyle, are likely to receive the maximum dose. Around Sellafield, the critical group is usually said to be the high consumers of local fish and shellfish; and (2) by estimating **collective doses**, the sum of many very small doses to sometimes very large populations (e.g. the whole world). There are concerns about both ways of evaluating the effects of discharges.

Critical Groups

In the past, when discharges have been authorised (for example, at the start up of THORP in 1994), doses to the critical groups have been said to be below the dose limit, and therefore acceptable. But this leaves many questions unanswered:

- Has the correct critical group been identified? Indeed, is it meaningful to talk about critical groups at all?
- Doses are usually estimated using models, in which there can be considerable uncertainties.
- There may be some pathways about which we are completely ignorant.

The above points might be purely academic were it not for the continuing and unexplained excess of childhood leukaemia around Sellafield. This was first brought to light in 1983, and has never (in my view) been satisfactorily explained. The orthodox view is that radiation cannot be responsible because the estimated doses are too low; this ignores the possibility that the doses might be seriously in error, for one or more of the reasons given above. Despite protestations to the contrary, it is I think still possible that childhood leukaemia (and possibly other cancers) around Sellafield are linked to radiation exposure, perhaps in combination with one or more additional factors.

In the light of these uncertainties, it seems irresponsible to continue to discharge significant quantities of radioactive material into the Irish Sea. It was doubly disturbing, at the time of the THORP authorisations, to be told that discharge limits were being *reduced*, when in fact actual discharges were going to *rise*. The Government Committee COMARE were particularly critical of this manoeuvre.

Collective dose

Collective dose, and its application, is even more controversial. If the LNT is correct, it follows that the number of cancers caused by a given collective dose can be obtained by multiplying the dose by a risk factor. This will be true even if the collective dose is made up of a very large number of very small individual doses. It's almost like a gunman being let loose in a city. If he's determined to kill one or two people, the risk to any given individual will be very small, yet the possibility of it should be prevented.

A study of the collective doses to EC Member States from routine discharges into north European waters, completed in 1989 found that the Sellafield reprocessing site was the dominant one, contributing 87% of the collective dose.[5]

Around the time of the THORP authorisations, Greenpeace pointed out that the collective dose from one year's Sellafield discharges could cause 200 fatal cancers. Various counter arguments were raised against this, notably that many of these cancers would occur in the distant future, and that the dose was in any case small compared with that from natural background radiation.The last argument is one that is frequently encountered in discussions about radiation, but is largely spurious, partly because of the ethical considerations I've mentioned above, and partly because the behaviour of some radionuclides in discharges may be qualitatively different from naturally occurring radionuclides, and dose estimation is an uncertain business.

The science is uncertain, and the ethical difficulties (as far as I can see) largely unacknowledged. Are deaths resulting from reprocessing acceptable? Can they be justified? It has been argued that many activites in our society (travel by car, for example) cause deaths, but the deaths (many would say) are justified by the benefits of the activity. Is this true for an activity such as reprocessing which produces a dangerous product (plutonium) without any conceivable benefits?

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[5] D Charles, M Jones and JR Cooper. Report of Working Group IV of CEC Project Marina. NRPB-M172