10 DOWNING STREET

From the Private Secretary

DR. NICHOLSON
CABINET OFFICE

SELLAFIELD

The Prime Minister was most grateful for your minute of 27 July, commenting on the distinction between alpha, beta and gamma radiation. She found this most helpful.

(David Barclay)

30 July 1984

CONFIDENTIAL

W.0493

27 July 1984

PRIME MINISTER

SELLAFIELD

There was some discussion at your meeting on Sellafield last Tuesday on the distinction between alpha, beta and gamma radiation. As this is fundamental to the strategy for reducing discharges, it may be helpful for me to clarify the essential points.

2. The composition of the radioactive effluent from Sellafield varies according to the processes in operation at a particular time, but about 60% arises from the re-processing of Magnox fueld. Because of the long half-lives of the radionuclides, the population exposure to the radioactivity comes not only from present discharges but from past discharges of differing composition.

3. Alpha emitters:

i. are mainly plutonium (238Pu with a half-life of 87 years; 239Pu with a half-life of 24,400 years; and 240Pu with a half-life of 6,600 years) and americium (241Am with a half-life of 433 years);

ii. have longer half-lives than the beta emitters;

iii. are mostly rapidly bound to sediments on the sea-bed. However, there is evidence that some of the activity is transported by currents in the water and some is re-mobilised to land by wind or sea spray; they can thus enter food chains or be present in dust.

CONFIDENTIAL

4. Beta emitters:

i. are mainly ruthenium (106Ru with a half-life of 1 year), strontium (90Sr with a half-life of 29 years), cerium (144Ce with a half-life of 285 days), caesium (134Cs with a half-life of 3 hours; and 137Cs with a half-life of 30 years), plutonium (241Pu with a half-life of 14.3 years) and tritium (3H with a half-life of 12.3 years);

ii. have shorter half-lives than the alpha emitters;

iii. are also the principal gamma emitters;

iv. tend to be mobile in sea-water;

v. enter marine food chains, where some (106Ru, 90Sr and 144Ce) are biologically concentrated, and are ingested by man in seafoods.

5. Alpha radiation:

i. can penetrate a few micrometres of tissue; and thus

ii. is hazardous only when ingested, inhaled or taken into a wound;

iii. leaves a dense trail of ionisation damage in tissue which is not easily repaired by natural mechanisms;

iv. is considered to be more harmful than an equal dose of either beta or gamma radiation by a factor of twenty.

6. Beta radiation:

i. can penetrate several centimetres of tissue;

ii. is hazardous only when ingested, inhaled or taken into a wound;

iii. causes tissue damage which is more readily repaired than alpha radiation damage;

iv. is considered twenty times less harmful than an equal dose of alpha radiation.

7. Gamma radiation:

i. can penetrate tissue easily; and thus

ii. is hazardous whether on the outside or inside of the body;

iii. is considered twenty times less harmful than an equal dose of alpha radiation.

8. The most important effect of radiation on biological tissue is damage of the genetic material in the cell nucleus. This can cause, in particular, sterility, hereditary defects and cancers.

9. Summary of discharges

The annex shows the estimated discharges, in terms of alpha and beta/gamma activities, from the storage ponds and re-processing plant.

RBN.

ROBIN B NICHOLSON
Chief Scientific Adviser

Cabinet Office
27 July 1984

ANNEX

Sellafield discharges

		discharges to sea in curies/year: alpha	discharges to sea in curies/year: beta/gamma
STORAGE PONDS	now →	38	33,600
STORAGE PONDS	on completion of SIXEP →	0	2,500
REPROCESSING PLANT	now →	342	26,400
REPROCESSING PLANT	effluent treatment (option 1/2) →	17	5,500

Cap de la Hague discharges

alpha	beta/gamma