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## Response to ‘Further information about the latest study of UK nuclear test veterans’ by Susie Boniface (2022 *J. Radiol. Prot.* [42 024505](#))

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The advertisement shows two pieces of radiation detection equipment. On the left is the ED3 Electronic Dosimeter, a handheld device with a blue screen displaying '0.0 pSv' and '0.0'. On the right is the GMS595 Wide Range Gamma Monitor, which has a larger screen showing '<0.10 μSv/h' and various status indicators like 'POWER', 'BATTERY', 'TOTAL', and 'STATUS'. Both devices are black with blue accents and are connected to cables.



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We thank Susie Boniface for her interest in our editorial. Her letter is wide-ranging. We largely limit our response to matters relating to mortality and incidence of cancer in the epidemiological studies of UK nuclear test veterans. Epidemiology deals only with effects on groups and we cannot comment on any individual cases. Nor do we comment on groups other than those included in this study; some of these other groups have been specifically discussed by Gillies and Haylock (2022). Equally, we do not express any views on criteria for awarding disability pensions. However, we respond to the other points in her letter.

## 1. Visibility and availability of report NRPB-R214

Ms Boniface claims that Report NRPB-R214 (Darby *et al* 1988a) is 'unpublished', 'suppressed', 'hidden' and has not been made available to the nuclear test veterans. This is untrue. The Report is referenced in the 1988 British Medical Journal (BMJ) paper (Darby *et al* 1988b) that was published in parallel with NRPB-R214 as a 'summary' (explicitly used in the title of the paper) of the methods and results presented in the report. NRPB-R214 was also cited in later publications (Dennis 1988, Darby *et al* 1990, 1991, 1993a, Muirhead *et al* 2003). As Ms Boniface acknowledges, it was explicitly mentioned in Hansard (1990) and later. Like the hundreds of other National Radiological Protection Board (NRPB) reports it was openly published and generally available. There can be no doubt that it was known to the veterans' organisations and their legal representatives. The study team discussed it with veterans' representatives and a contemporary report in *New Scientist* notes that Ken McGinley, then Chairman of the British Nuclear Test Veterans Association (BNTVA), was critical of it (Connor 1988). It was cited in the 2009 legal case in which BNTVA members sued the UK Ministry of Defence (AB & Others v Ministry of Defence [2009] EWHC 1225 (QB)).

We concede that NRPB-R214 had a cover price (of £8.00). We believe that the charge was generally waived for members of the public who approached NRPB for single copies. However, some readers may have had to pay. Perhaps it would have been better if we had said that the report was 'generally available' rather than 'freely available', which would have avoided any misunderstanding.

## 2. High leukaemia risks

Ms Boniface says of NRPB-R214

These 140 pages show rates of leukaemia among test veterans 2.5–3.3 times greater than controls, for those who served at weapons tests in the Pacific Ocean and the minor trials. And among servicemen not thought to have been exposed or even present at explosions, leukaemia was 6.5 times that of controls.

We believe that she is looking at table 7.13 of report NRPB-R214. But there is no need to go to the report (Darby *et al* 1988a). These relative risks are also given in table V of the BMJ paper (Darby *et al* 1988b) and are discussed there.

### 3. Fallout

Ms Boniface says that test veterans attribute health problems to fallout. Fallout, of course, is radioactive material from nuclear explosions: fission products, activation products and unfissioned bomb material. Fallout can be local to an explosion or global. The latter was of general public concern in the 1950s (Kendall *et al* 2021) and it is natural that test veterans should have had fallout in mind. Fallout can give external or internal radiation doses. The former are from more-or-less penetrating radiation and would be measured on film badges. Internal radiation doses come from radioactive material that has been inhaled or swallowed. Those organising the tests were aware of the dangers of fallout and marked out areas where it was thought to be a potential problem and controlled access to them. After the event, it is impossible to prove that this was always done perfectly, but we are certainly unaware of any evidence that dangerous mistakes were made.

As we say in the editorial, we attach weight to the fact that Australian scientists undertook a retrospective dose analysis at Maralinga, considering both internal and external radiation (Carter *et al* 2006, Crouch *et al* 2009). They concluded that external doses were substantially bigger than internal doses and that Australian dose estimates were broadly similar to those used by UK investigators.

### 4. Study design

Ms Boniface has various criticisms of the study design. On some points she is clearly wrong. She says

In the official studies, all that is considered is the length of life and reason for its end.

In fact, cases of cancer even if non-fatal have been included in all analyses. She goes on to say

... the 1988 authors ... decided that all test veterans who had died abroad would have died from accidents or heart disease, and therefore could be discounted.

In fact all study subjects who emigrated, whether cases or controls, left the study on the date of emigration. This is because of the impossibility of unbiased follow-up outside the UK. No assumptions are made about causes of death after emigration. Ms Boniface then says

Kendall and Little do not address the main failing of this research, which is that it was not designed to answer the questions veterans asked.

In fact, the study was set up in 1983 (Reissland 1983) to respond to veterans concerns about levels of leukaemia and lymphoma (Knox *et al* 1983a, 1983b). Concerns about mortality and malignant disease (particularly multiple myeloma) continued (Roff 2003). Further description of the reasons for the study design are to be found in Kendall *et al* (2004), section 4, and in report NRPB-R214, section 2 (Darby *et al* 1988a).

It is true that other health concerns have been raised since the study was set up. To investigate these would require new and quite different studies. Studies other than mortality or cancer incidence (which can use national registers) would be much more complicated and less reliable given the various types of bias that studies with active follow-up are prone to.

### 5. Shortcomings of dosimeters

Ms Boniface claims

The Mirror has uncovered documentary evidence that dosimeters malfunctioned, were so insensitive they could record only doses hundreds of times greater than the 'safety' limits ...

Unfortunately, her supporting reference is a weblink to a file of over 130 Mb in size, which is not indexed or machine-searchable. It has over 300 pages, some of which are handwritten or faint to the point of illegibility. We have examined the document, but certainly not completely, and did not find anything that would justify her claim. If she can produce a specific supporting document, we will respond to it.

There is a general description of the radiation exposure of test participants and how it was measured in section 6 of Kendall *et al* (2004). The personal monitoring was carried out by the then Atomic Weapons Research Establishment's (AWRE) Health Physics Group who were also responsible for personal monitoring at AWRE. Details of the threshold of detection of the dosimeters is in section 2.4 of report NRPB-R266 (Darby *et al* 1993b). The minimum recordable dose was generally at most 0.5 mSv and usually rather less. The exception was the Buffalo Indoctrinee Force (about 170 men) where the minimum recordable dose was 4 mSv.

## 6. Our conclusion

Ms Boniface suggests that our conclusion ‘further research is required’ is not very satisfactory. We agree. However, we have a situation where there are suggestive hints of excess disease in veterans compared to controls. In the editorial we discuss possible reasons for this without finding a convincing candidate. More data might clarify the situation.

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