



[REDACTED]
Sizewell C RSA permitting lead
Nuclear Regulation Group (South)
Environment Agency

16 February 2021

Your ref: EA\SZC\RSR\O\010

[REDACTED],

Re: Request for advice from PHE on matter raised in consultation response on an environmental permit application

Thank you for your letter dated 10 September 2020 regarding a request for advice from PHE in relation to a response you have received during the consultation on the environmental permit for the proposed Sizewell C nuclear power station.

One of your respondents to this consultation raised matters relating to the impacts of radiation on health which referred to two documents:

1. A report that the respondent says provides evidence of greater potential health impacts from radiation than predicted from currently accepted dose/risk models. This report is available here: <http://www.llrc.org/children.htm>.
2. A communication submitted to the journal "Health Physics" by Dr Christopher Busby which you provided a copy of by email. The respondent asks whether there is a need to appraise the dose from uranium-234 to the Life-Span Study population and whether PHE will consider the impact of that information on the reliability of ICRP risk factors.

The two documents have been reviewed by PHE and the following describes the summary of these reviews.

Document 1: Radiation and reason: The impact of science on a culture of confusion.

This report puts forward the views of the Low Level Radiation Campaign (LLRC) concerning a wide range of radiation protection issues. One of the group's main concerns is that it disagrees with the way in which studies of the survivors of the atomic bombings of Hiroshima and Nagasaki are used by the International Commission on Radiological Protection (ICRP) to create a system for radiation protection to predict risks from ionising radiation to the public and to occupationally exposed workers.

Much of the material appears to be restatements of issues raised in previous material produced by this group or its members. It does not appear contain any original peer reviewed scientific research.

Many of the groups concerns have already been considered by the CERRIE committee which included several members of LLRC. The final report of CERRIE found no good scientific evidence that there were any major issues or fundamental flaws with the system of radiation protection derived by ICRP and a view which is endorsed by the overwhelming majority of the scientific community.

The CERRIE report was reviewed by COMARE in its 9th report which generally endorsed the conclusions of CERRIE. However, it should be noted that the CERRIE final report was not supported by the LLRC members on the committee who produced an alternative report.

There is part of the 'Radiation and reason' report (section 6.2.3) which is more recent and is based on a paper written by Busby published in February 2020 in which he claims to have found a large excess of cancers among sailors serving aboard the nuclear powered ship, the USS Ronald Reagan, which he claims was sufficiently close to the Fukushima reactor accident to have been contaminated. However, the validity of the data, the analyses that underpin this result and the interpretation have been thoroughly undermined in a response to the paper published in the same journal by Prof Richard Wakeford.

References

Busby C, High Cancer Risk in US Naval Personnel Serving in Nuclear Powered Ships Cancer Investigation, DOI: 10.1080/07357907.2020.1731526 , 2020

Committee on the Medical Aspects of Radiation in the Environment (COMARE) 9th Report: Advice to Government on the review of the radiation risks from radioactive internal emitters carried out and published by the Committee Examining Radiation Risks of Internal Emitters (CERRIE). ISBN 0-85951-547-8

Report of the Committee Examining Radiation Risks of Internal Emitters (CERRIE)
<https://webarchive.nationalarchives.gov.uk/20140108135436/http://www.cerrie.org/>

Wakeford R, Letter to the Editor: Purportedly High Cancer Risk among US Sailors on Nuclear-Powered Ships Cancer Investigations, DOI: 10.1080/07357907.2020.1782420, 2020

Document 2: The Hiroshima A-Bomb black rain: a resolution of the enigma. Submission to Health Physics.

Here Busby suggests there is an unexplained enigma concerning deviations from a circular pattern round the hypocentres of cancer risk among survivors of the Hiroshima and Nagasaki bombings. He suggests that this might be due to a failure of researchers to take account of exposure to residual radioactivity from the bombs in the rainfall, the so called 'Black rain', that occurred shortly after the bombs exploded over parts of the two cities.

He contests that the failure to take account of this additional indirect exposure in the dosimetry system used to estimate the doses to the survivors invalidates these calculations and therefore that the risk coefficients derived from the LSS are not sound.

This might matter because it is these risk coefficients that ICRP uses as the basis for its recommendations and which form the basis of the UK radiation protection regulations.

A range of texts are cited to support his point of view many of which have not been through a peer review process and are effectively self-published.

However, there are two which appear to be relied on most to support his argument which are published in peer reviewed scientific journals; Tonda et al 2012 which is a study of the spatial distribution of cancer mortality in Hiroshima survivors that shows an asymmetry to the pattern of risk, and Watanabe et al 2008 which looks at the risk of cancer in both the Hiroshima and Nagasaki survivors compared to two control groups and finds high cancer risk in survivors with very low doses compared to the control groups.

He suggests that the results observed in both studies could be explained by survivors being exposed to 'Black rain' if the survivors received significant indirect radiation exposure because of their exposure to the rain.

However, the two studies he relies on here do not provide good evidence that the 'Black rain' was an important source of radiation exposure to the bomb survivors as noted in the following sections.

Tonda et al

In this study, contour maps are derived to indicate the areas of higher and lower cancer risk in Hiroshima in relation to the hypocentre of the explosion. Even if the somewhat asymmetrical contour map is taken at face value the association between the areas of higher risk and the areas of estimated high and low rainfall are distinctly vague – which Tonda concedes. Tonda also acknowledges that there are several other non-radiation factors that might explain the asymmetry of the risk pattern such as socioeconomic status, lifestyle and environmental factors.

Given the fact that the city will certainly not be homogeneous with respect to these other non-radiation factors that will affect baseline cancer incidence and that an individual's radiation related cancer risks also vary in relation to their baseline risk it is very unlikely that a symmetrical risk pattern related to radiation exposure from the bomb would also be created.

Thus, the results of the Tonda paper are completely plausible in the absence of any 'Black Rain' effect.

Watanabe et al 2008

In this study, the number of deaths and cancer cases among very low, low and high exposure Hiroshima bomb survivors are compared to those that would be expected based on the rates of cancer in the whole of the Hiroshima prefecture and on the rates in the neighbouring Okayama prefecture. Standardised mortality ratios (SMR's) are calculated for each dose group and Watanabe finds significantly raised SMR's for some disease groups in the low and very low dose groups.

He contends that this means that if the dose calculation methodology is correct then risks at these low doses received directly from the explosion are underestimated or that contributions from residual exposures have been underestimated.

This conclusion has been effectively challenged by Grant et al 2009 for several reasons. The first being that any unaccounted radiation exposures would likely have affected men and women equally, However, only the SMR for all solid cancer among men is raised in the very

low dose group and not that among women. This suggests that non-radiation factors are likely to be the cause of the raised SMR among men in this group. Furthermore, if the excess risk among the male members of the very low dose group was correct then doses to this group would need to be very large – far more than would be plausible from a failure to account for indirect exposures.

Thus, it is considered that both of these studies fail to support Busby's concerns about 'Black Rain'.

Two other studies have been published in high quality peer reviewed scientific journals in the last few years that provide good evidence against Busby's 'Black rain' enigma.

Sakata et al 2014 compared cancer rates among bomb survivors who reported exposure to rain with those who reported no rain exposure and found only weak evidence for an effect on deaths among Nagasaki survivors over the whole period from 1950 to 2005 but found no effect when mortality data were restricted to the time period after the questionnaire was estimated to have been undertaken. The use of the reduced period aims to exclude the possibility of recall bias. Furthermore, no evidence was found for a difference in risks for cancer incidence in either Hiroshima or Nagasaki between those reporting rain exposure and those who did not.

Ozasa et al 2016 examined the reported occurrence of acute radiation symptoms and exposure to rain among 93,741 atomic bomb survivors in the Life Span Study cohort. The proportion of survivors who developed one of the most easily recognised acute symptoms, severe hair loss, was around 60% at high direct radiation dose levels but less than 0.2% among the 30,000 survivors with very low dose levels regardless of reported rain exposure status (overall 23% of survivors reported rain exposure in the low dose group). The low prevalence of acute symptoms at low direct doses found in this study provides good evidence that the reported fallout rain was not homogeneously radioactive at a level sufficient to cause a substantial probability of acute symptoms.

Busby does reference the Sakata paper however he does not recognise that it provides evidence against his position. He suggests that survivors who receive low direct exposures could have received indirect exposures from the rain which were sufficient to cause acute effects but that the dose to the whole body from such radiation would not show up in studies of cancer risk many years later. However, the results of the Ozasa paper reject even the hypothesis that there were significant numbers of low dose survivors who experienced acute effects.

For all these studies it must be recognised that much of the information about rainfall and survivor's exposure to it was self-reported via questionnaires undertaken sometimes many years after the events which means the accuracy of these data is difficult to ascertain. So it is likely to be impossible to provide completely definitive proof regarding the potential effects of the black rain however non-radiation effects on health such as economic status, environmental effects and lifestyle are very commonly seen in other epidemiological population studies and are also likely to be important in studies of the atomic bomb survivors.

Therefore, Busby's contention that "something that is associated with the black rain is associated with cancer risk in all the LSS exposure groups" does not appear to be credible. While Busby's manuscript has been submitted to Health Physics it has not been published so far. It should also be noted that in his conflict of interest statement Busby claims to act as an expert witness in cases involving internal radiation exposure. However, in relation to the case of Abdale and Others vs. Secretary of State for Defence 2016 which Busby references he was not allowed to appear as an expert witness for the plaintive as the judge did not recognise his expert status in any relevant field.

References not given in the original document

Ozasa K, Sakata R, Cullings HM, Grant EJ Association of Acute Radiation Syndrome and Rain after the Bombings in Atomic Bomb Survivors RADIATION RESEARCH 185, 604–615 (2016)

Grant EJ, Shimizu Y, Kasagi F, Cullings HM, Shore RE, Commentary: Radiation unlikely to be responsible for high cancer rates among distal Hiroshima A-bomb survivors Environ Health Prev Med (2009) 14:247–249 DOI 10.1007/s12199-009-0087-8

Responses to the questions posed:

- 1) A report that the respondent says provides evidence of greater potential health impacts from radiation than predicted from currently accepted dose/risk models. This report is available here: <http://www.llrc.org/children.htm>.

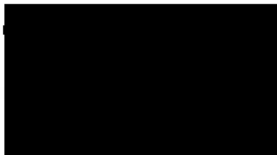
The report does not present any new good evidence to support the view of the respondent. The issues raised have been already been addressed in various forums and found to be without merit.


- 2) A communication recently submitted to the journal "Health Physics" by Dr Christopher Busby as included in this email. The respondent asks whether there is a need to appraise the dose from uranium-234 to the Life-Span Study population and whether PHE will consider the impact of that information on the reliability of ICRP risk factors.

The communication does not provide any good evidence that the dosimetry systems used to estimate doses to the atomic bomb survivors have failed to account for any significant exposures that could have come from sources other than direct exposure at the moment of the explosions.

In summary, PHE do not consider that the documents referred to provide an additional evidence that would require changes to your radiological dose assessment methodology which is based on the recommendations of the International Commission on Radiological Protection.

Yours sincerely




Head, Radiation Assessments Department

