

Case Nos.

(1) ENT/00250/2015

(2) ENT/00251/2015

**IN THE FIRST TIER TRIBUNAL
WAR PENSIONS AND ARMED FORCES COMPENSATION CHAMBER**

B E T W E E N :

**(1) Mr Donald Battersby (Dec'd) NINO: ZM 29 03 08D
(Ms Kay Battersby)**

(2) Mrs Anna Smith widow of Barry Smith (Dec'd) NINO: ZS 23 06 67 B

Appellants

-and-

SECRETARY OF STATE FOR DEFENCE

Respondent

Revised AMENDED STATEMENT OF CASE

Christopher Busby

Andrew Ades

1

Introduction

1.1 This Revised Amended Statement of Case is served on behalf of the Appellants listed above. It was prepared as a result of the Order of Blake J at the Case Management Hearing of 6th May 2016 following representations by the SSD.

1.2 We endorse and adopt the arguments put forward by the HL appellants.

1.3 We begin by pointing out, as further elaborated below, that the SSD has repeatedly failed to follow the Tribunal's orders with regard to responding to our first Statement of Case, a concern which is also shared by Hogan Lovells.

1.4 We advance the following main grounds, all of which are contained in expert reports and/or the previous evidence, which was and still should be in the bundle:

- the standard of proof and evidence (which must be applied to previous testimony and new alike);
- the new evidence of the evolving scientific opinion showing that the ICRP's methodology, employed by the SSD's experts, is unsafe when applied to internal radioactive exposures, especially to Uranium
- the specific evidence for genetic damage in the veterans and the veterans' offspring
- the evidence of exposures to Uranium derived from the weapon device residues, particularly U-234 and U-238
- The evidence from the Gisted (Bevis Parker) document that in terms of mass, 99% of the fallout and rainout was from Uranium
- the evidence for rainfall which will have caused hot spots of very highly radioactive rainout material including Uranium
- The evidence that the sticky paper detectors were unusable for recording radioactivity from rainout contamination.

We deal with these points below.

Access to Available Evidence from the Previous Hearings

1.5 Previous evidence to the earlier hearings was contained in two bundles, the First Tier (FtT) 2013 bundle and the Upper Tier (UT) 2014 Bundle. This latter was believed to have contained the previous papers and reports from the FtT bundle but it appears that the SSD had removed many documents, at least 144 documents according to a comparison between the indexes for the FtT and UT bundles. This was identified by our clerk Mr Williams who painstakingly went through the data.

1.6 The B&S Appellants' representatives have never been given a full set of the previous bundles and so have not been able to see all the information necessary to inform their case and their arguments. To date, despite repeatedly contacting the SSD and making the point that we need access to all the previous documents, these were provided to us on 12th May after we

approached the Tribunal on 11th May. We therefore reserve the right to add to or modify this statement of case when we have had time to consider all the previous bundles and in particular the 144 documents which the SSD had removed. In what follows, we may refer to a paper or a report which we know was in the bundle to the previous FtT or UT but to which we are unable (since, in the available time, we have not yet been able to find it) to give a location. Further, with regard to the references and citations in the text that follows, we have been unable to locate the position of the documents we cite in the bundle, since (a) this has not been assembled, (b) there are currently concerns about its completeness, (c) we have only just received the missing elements, and (d) expert papers cited by both the SSD's experts and ours have only just been provided to us and/or the SSD for inclusion. We propose to locate these when they are tabulated in the agreed bundle.

The Standard of Proof

1.7 As noted above, we endorse and adopt the arguments so appropriately made by the HL Appellants especially those concerned with Charles J's decision in the UT concerning the 'stepping stone' approach to be undertaken by a tribunal in its fact finding role. We present our proposed 'stepping stones' in a separate section below.

1.8 However, we go further: that approach must, following the UT's decision, be taken conjointly with an assessment of all the evidence in a clearly defined decision-making process involving some 6 stages:

- (a) **Onus of Proof** – the appellants must adduce evidence from which the 'possibility' of a 'reasonable doubt' can be inferred.
- (b) **Reliability of Evidence** – such evidence must be 'reliable', by which is meant, however, nothing more than its being not 'fanciful' or 'worthless' (see §5 (i) of Upper Tribunal Reserved Decision – 'UTRD').
- (c) **Admissibility of Hypothetical Evidence** – in particular, evidence of a hypothetical character or nature could be as relevant as is direct evidence of a more tangible nature, depending upon its reliability (see §112-113 of UTRD).

- (d) **The Evaluation** – the Tribunal should take forward all of the evidence they have heard that they consider raises any possibilities relevant to the Appellants’ case, and should then proceed to an evaluation of the respective cases of the parties, by reference to all of the competing evidence and argument (see §5 (iii) of UTRD). They should then proceed to an evaluation as to whether there is a ‘reasonable doubt’, by applying a ‘threshold test’.
- (e) **Threshold Test** – to do so they should apply a reverse ‘criminal standard’ of proof test.
- (f) **Reverse Criminal Standard to be applied** – in order to apply the requisite ‘threshold test’, the Tribunal has only to ask itself whether it is sure that the disease or death in question did not arise as a result of exposure to ionising radiation during service. If it is not so sure then it must follow that the doubt raised, by the Appellant’s reliable evidence, is reasonable, and it follows finally that the Appellants must then be given the benefit of it (see in particular §118-122 of UTRD).

1.9 That is, we submit, now the applicable law, as handed down to us by the Upper Tribunal, following a full and thorough appeal on the very point. With the greatest respect, it is not now within the gift of those representing the SSD to rewrite, or in any other manner whatsoever try to place any ‘gloss’ on that finding. In particular, it is not, as they state in their original Statement of Case, for this Tribunal now to ‘*decide where that threshold should fall*’ for itself (see at §8 of the SSD’s Statement of Case in Reply to HL’s). To succumb to that invitation would be to give the SSD a second bite at the very cherry which he was denied in the UT. We further discuss the relevant legal issues in Appendix 2.

1.10 Importantly, the expert evidence which we have gone to some trouble to produce is predicated on the above standard of proof (i.e., that flowing from Charles J in the UT) and it is fundamental to the hearing of these crucial cases on which so much depends for so many that the same standard is applied to all witnesses.

1.11 We are, of course aware – and make no criticism here – that the SSD’s experts in the previous FtT provided opinion based largely on the civil standard applicable in the civil courts and applied with, in our view unreasonable hope, to the cases of our and HL’s

appellants. And we also opine that at least some of the new experts provided by the SSD incline to that standard, possibly because they are most familiar with it and also because it is all too easy to fall into the view that evidence and opinion should be ‘reasonable’ rather than as is the proper test in law that it should be ‘reliable’ in the sense that it is not ‘fanciful’ or ‘worthless’.

1.12 Whilst we intend, with the Tribunal’s permission, to press the above points in more detail in the full hearing, we here seek the Tribunal’s acknowledgement to examine the old and new evidence put forward by the SSD on the basis of, as in bearing in mind the while, the standard of proof threshold test as determined in the UT. We appreciate that it could well be very costly and difficult (and obviously impossible in the case of the late Mr Johnston) to ask to cross-examine all the SSD’s expert witnesses in the previous FtT, but we do seek to examine the SSD’s new experts on their own evidence and their opinion of the old expert opinions as such might be given in accordance with the now established standard of proof test. In short, those previous experts gave opinions against the ‘balance of probability’ test which is no longer (if it ever was) applicable to the important work of this Tribunal and all evidence should now be tested per paragraph 8 above, which is merely a summary of the Hon Mr Justice Charles’ decision in the UT, a decision that has not been appealed by the SSD and which is further outlined in Appendix 2.

‘New’ Evidence on the IRCP risk Model

1.13 There are several particular strands of ‘new’ evidence, which we detail below.

1.14 The expert statements of Professor Schmitz Feuerhake, Professor Sawada, Professor Hooper and Professor Howard clearly lay out the argument and supporting evidence for our contention that the ICRP and similar models relied on by the SSD’s expert witnesses cannot be used for assessing internal radiation effects. These models were based upon the Japanese Lifespan and other external radiation studies and these were silent on internal exposures. As Professor Schmitz Feuerhake’s statement points out, there is new evidence from Chernobyl and other studies that congenital diseases (i.e., indicators of congenital damage in the parents) can be found in children and grandchildren whose fathers were exposed to internal doses below 1mSv. Both Mr Battersby and Mr Smith were exposed to more than 1mSv even according to the SSD’s expert, Mr Hallard.

1.15 Following this, Professors Howard and Hooper both discuss in some detail in their expert statements evidence that the veterans suffered radiation exposure at levels capable of causing genetic damage to sperm as shown by epidemiological studies of their children and grandchildren, which also provides late objective evidence of their earlier exposures. Prof Howard (who submitted a report on this issue) found that the Dundee data on the British Nuclear Test Veterans Association, obtained following the 3rd Party Disclosure Order, showed a 10-fold excess risk of Congenital Malformations in the children and a 5-fold excess in the grandchildren of the veterans association. We say that this is objective proof of prior exposure at levels capable of causing genetic damage.

1.16 Further evidence of genetic damage is given by the Wahab/Rowlands et al. New Zealand Test Veterans chromosome aberration study [1], which was part of the evidence to the previous FtT and should be in the bundle.

1.17 There is new evidence from photographs of the fallout clouds emanating from the tests (supported by eyewitness statements which we have submitted); meteorological records of the conditions in and around the test sites at and around the times of the explosions and reports of significant rainout after the tests. Photos and some IWM videos show apparent entrainment of terrestrial material from all the land based tests in Buffalo and Grapple X, Y and Z1 and Z4. Despite to Grapple test series all being air bursts, photos suggest entrainment of water vapour or sea water from most of the Grapple offshore tests. Glasstone suggested that entrained material increases the likelihood of radioactive local fallout or rainout [31].

1.18 The eyewitness statement of Mr Archie Ross [2] describes his observations of sea water being sucked into the stem and of heavy rain over the port area after the Grapple Y test. We also adduce evidence from other eyewitnesses including Mr Derek Fiddaman whose witness statement [3] describes sea water being sucked up into the Grapple X mushroom cloud stem. Similarly, both the meteorologists who gave evidence before the previous FtT, Mr Stretch and Mr Nicholson, and whose expert reports are in the bundle, addressed the issue of rainfall from the radioactive clouds, and Mr Stretch referred to Flt Lt Joe Pasquini's evidence to the previous FtT which reported radioactive rain in which the meter needles for the radiation detectors in his aircraft 'went off the clock'.

1.19 Accordingly we draw attention to Prof Sawada's expert report where he states that the precipitation of radioactive residues from the weapons by rain is quantitative and caused the effects on cancer and immediate damage which he described at Hiroshima and Nagasaki [4]. We thus rely on Prof Sawada's evidence that following such rainout, there will have been hot spots where the rain fell where radioactive contamination was very high, a matter that does not seem to be addressed by Mr Hallard in his dose calculations.

1.20 The reason that such hot spots may have been missed is given by the McDougall memorandum [5], which was in the FtT Bundle but which we have just received since it was omitted from the UT (Upper Tribunal) bundle. McDougall advised that sticky papers should be taken in if it rained as the rain washed the radioactivity from the filters. Of course, if they were taken in, then they will have not registered the radioactivity in the rain. If they were left out, it would have been washed off. So either way, the fallout results presented by the Clare report on which the SSD's expert Mr Hallard, and previous experts for the SSD, relied are unsafe [6].

1.21 Professor Howard [7] Professor Schmitz Feuerhake [8] and Professor Hooper [9] give evidence in their statements about the element Uranium, which was the main radioactive component of the bombs tested in terms of mass, as admitted by Mr Hallard in his answer to that specific question. This element Uranium has been shown by our experts, Howard and Hooper, to exhibit anomalous genotoxicity. As all our experts argue, the ICRP model employed by the SSD cannot be safely employed to calculate genetic effects. Indeed, as they all point out, the European radiation research organization, MELODI, has recently committed a large amount of money to an investigation of the particular toxicity of internal uranium contamination in Europe, suggesting that the ICRP model is now not considered safe or reliable for this element [10].

1.22 Although the SSD refused to release a document which showed the high concentration of the radionuclide Uranium-234 in the enriched Uranium employed by the British, happily the US have recently declassified a document that shows this. The evidence from the Rocky Flats report discussed by Professor Hooper (Kazanjian 1976, [11] [28]) shows that the main radioactive component of the Uranium was U-234, which was present in the enriched Uranium used for all the bombs and present in the fallout and rainout. Previous, and indeed the present, discussions and dose calculations of the SSD and their experts have omitted to

consider Uranium exposures. There is evidence, as discussed in the statements of Schmitz Feuerhake, Hooper and Howard, that these are critical to explanations of the excess cancer and genetic damage suffered by the veterans.

1.23 We give advance notice to the experts of the SSD that we propose to ask them under cross-examination to respond to the evidence in the Woods Hole Oceanography measurements of Uranium on Coral Islands, which was in the earlier bundle, as proof that the SSD's previous assertions regarding the background doses at Christmas Island were incorrect and the absence of Uranium on Christmas Island was also incorrect [12].

1.24 We give advance notice to the experts of the SSD that we propose to ask them through cross-examination to address the statistical evidence relating to the improbability that 4 appellants in these cases died from pancreatic cancer without them having a common environmental exposure for that circumstance. Mr Trevor Butler, one of the Hogan Lovell appellants has just died from pancreatic cancer. That makes 4 of the appellants – Butler, Williams, Battersby and Smith – who died from this cancer. We will ask Drs Haylock and Prof Thomas separately to compute the cumulative probability that 4 unrelated individuals with only the presence at the test sites to connect them all died from pancreatic cancer, given the national published background age-related mortality rates for the disease. We will ask them to comment on this in relation to their evidence.

The Process of Making Our Case, and Responses of/to the SSD

1.25 When we asked if our experts might provide supplementary reports which engaged with the Secretary of State's (SSD) experts we were admonished for attempting to engage in a 'ping pong' match between experts. In our innocence of legal matters, we had thought that such a process was part of the way that the truth emerged; it was certainly the way in which the previous First Tier (FtT) Stubbs J handled the process. We have been somewhat wrong-footed by this mistake, as the SSD's expert questions to our experts went beyond the simple matter of elucidation of difficult points, but rather attempted to attack the substance of the reports by referring to papers which were believed to falsify or counter the arguments of the B&S experts. We did not do this in return and therefore our questions about the substance of

the SSD's experts reports will have to be made in cross-examination, but will also be implicit in this amended Statement of Case.

1.26 The Appellants' Statement of Case was submitted to the Tribunal on 2nd April 2015 and was produced in accordance with the Directions of the Pensions Tribunal Upper Tier (UT) of 4th December 2014 following Charles J's Decision to allow the Appeals and remit them to a newly constituted First Tier. Following a dismissive response from the SSD we provided a Memorandum on 13th May 2015 focusing on Issues, Possibilities and Certainties. Next, the Appellants' experts' reports were submitted by the beginning of October 2015 as required. However, although the SSD's experts had been Directed to respond to the Appellants' Statement of Case and their expert reports by the end of November, yet their final expert report submission, following sequential pleas for more time, finally appeared in January 2016, an interval of more than three months from the submission of the Appellants' experts reports.

1.27 Although the SSD had been Directed to respond to the Appellants' Statement of Case, the SSD's revised Statement of Case of 20th Jan 2016 did not do so. None of the principal arguments advanced by the Appellants was rebutted or even discussed by the SSD. Indeed, it was stated (Para 14) that there was 'no need' to do so:

'14. As the (SSD's) experts were instructed to consider all of the possibilities and certainties advanced in the Hogan Lovell's and Battersby Smith Statements of Case, it is submitted that there is no need for the Secretary of State to respond, line by line, to each and every one of those possibilities and certainties.'

1.28 On the evidence of their own reports, none of the experts commissioned by the SSD appeared to have even read the Statement of Case of the Appellants, nor any of the Expert Reports presented on their behalf by the four eminent scientists who were commissioned. The SSD experts simply ignored the case advanced by the Appellants and wrote their own reports, based on the very conventional ICRP methodology which the Appellants are questioning. The SSD experts calculated doses to high degrees of precision (though not, we argue, accuracy) and submitted the conventional ICRP dosimetric causation argument as if no one had questioned its applicability or validity. Much has been made of the independence of Dr Busby in connection with his activism, and this has resulted in his exclusion by the Upper Tier

decision as an expert in these appeals. This is the reason that this revised amended Statement of Claim has been requested by the present FtT, in order to try and remove any statements which might be construed as expert statements. However, we raise here the question of the independence of all of the SSD's expert witnesses, who all are associated with the nuclear industry and the ICRP radiation model which is being questioned by our experts.

1.29 Even at the stage of asking questions of the Appellants' experts, there was little attempt to question the principal points made. In the case of Prof Sawada's report, which showed that the epidemiological basis for the risk model employed by the SSD's experts was unsafe because of internal radiation effects, the SSD merely demanded a translation of a report which had already been written in the English language. We find this approach puzzling in a legal arena. In order to direct the attention of the Tribunal to the key questions and the evidence submitted through the experts on both sides, we will attempt to deconstruct the arguments for and against in Section 2 and 3 below.

1.30 Our approach to producing this revised amended Statement of Case, therefore, is to move forward from the original Statement of Case, retaining all the points advanced there, but incorporate such new information that has emerged through the disclosure exercise, the new expert reports and the exchanges of questions and answers. In particular, we believe it may be helpful to employ the method we used in the Memorandum of May 16th 2015 to lay out the 'stepping stones' necessary for the Tribunal to decide on the issue of causation. We request that our identification of the issues, given below, are incorporated into, or form the basis for the list of issues to be prepared by the SSD and to be addressed by the Tribunal. We divide this submission into further sections as follows:

- (2) The case
- (3) The sequence of arguments
- (4) Stepping stones, possibilities and certainties
- (5) The conclusion

Included at the end are two Appendices, A1 being a copy of a decision by an Australian Tribunal that considered the safety of the ICRP model for internal radiation exposure and which the parties may find of interest in the current context, and A2 being a copy of our earlier assessment in the First Statement of Case of the law as discussed by Charles J in the UT Decision to remit these case.

1.31 We make one early point about the issue of bias in expert evidence. This question of bias was raised particularly in the UT by the SSD with regard to Dr Busby's activism and was referred to in the SSD's Statement in the current appeal. Charles J decided that Dr Busby could not be an expert witness in these hearings because he was an 'activist' and this would colour his approach. An attempt to question the legality (though not the spirit) of this decision through a Judicial Review application was dismissed, and so the legal basis for Charles J's decision never went for Judicial Review. It may be of interest that in a recent appeal by a appellant in a Depleted Uranium case, *Forbes vs. SSD*, the Upper Tier Judge has refused the SSD's request based on the Charles J decision to exclude Dr Busby's evidence and has left the issue of Busby's appearance as an expert to the new FtT. We nevertheless accept Charles J's concern about bias, but we feel, as we said in the UT, that all experts are biased by their employment and scientific culture. So we argue that the Tribunal may at least decide on what weight to attach to the evidence presented by the experts fielded by the SSD who all have strong financial and cultural connections with the nuclear industry or indeed the ICRP and the other international risk agencies. The evidence of Mr Bramhall with regard to the CERRIE committee makes clear that this kind of bias towards maintaining the accepted *status quo* frequently operates in the scientific community, despite a perception from outside that science is an open, rational system based on evidence.

2

The Case

2.1 All the appellants in this case, including Mr Battersby and Mr Smith, but also the veterans represented by Hogan Lovells, and a large number of veterans whose appeals have been stayed awaiting the outcome, were stationed at one of the nuclear test sites either in Australia or Christmas Island.

2.2 It is now agreed between all parties that whilst there, whether during tests or after tests, or even after the tests had all finished, all veterans were exposed to internal radioactive material derived from fallout and rainout accumulated at the locations, as well as external radiation from fallout and rainout residues accumulated on the ground, in food, water, and air. Some of the appellants wore radiation detecting 'film badges' and had recorded doses from the external radiation to which they were exposed.

2.3 It is now agreed by all parties that these film badges were effectively sensitive to external gamma radiation only and could give no direct information about internal exposures.

2.4 Appellants have argued that their exposures have resulted in their illnesses. The SSD has responded in the previous FtT and also in the current one that these exposures could not have caused their illnesses, since the radiation ‘doses’ were far too low.

2.5 We argue through our experts that the concept of ‘dose’, which is currently how radiation is assessed by the international radiation protection regime (that of the International Commission on Radiological Protection, the ICRP) [13] cannot safely be applied to internal exposures, and that for some radionuclides, especially Uranium, which was the principal radioactive component of all the bombs tested, and will have represented more than 95% of the contamination in terms of mass, there are further considerations to do with its affinity for DNA and its high atomic mass. We submit and discuss evidence from our experts and from the scientific literature that demonstrates this and will further explore this issue with the SSD’s experts under cross-examination.

2.6 Additionally, we advance the parallel argument that the approach to deciding the issue laid down by Charles J should lead to a successful appeal even if the baseline ‘doses’ as calculated by the ICRP methodology and the assumptions made by the SSD’s experts about ICRP models were correct.

2.7 Our principal argument thus pivots on whether the ‘doses’ calculated by the SSD’s experts are correct or meaningful in the context of internal exposures to weapon test residue contamination including Uranium, and whether these ‘doses’ can be translated scientifically in each appellant’s case into a risk of their developing cancer or a non-cancer illness.

2.8 There have been some significant changes in the position of the SSD since the previous FtT, as they have directed their experts to accept the ‘possibilities’ of further contamination than those they thought likely or ‘reasonable’. These concessions are important and are listed in the table below:

Item and Previous position of SSD	New position	Reason (if given)
No rainout from test clouds Christmas island	Rainout now accepted as a 'possibility'	
Mushroom cloud moved away from Christmas Island due to wind direction at ground	Now accepted that upper winds were in opposite direction and material blew back over island. Grapple Y Cloud covered island and was stationary over island for significant period (hours)	Meteorological experts evidence. Evidence from eye-witnesses.
Claim that background dose at Christmas Island much lower than UK	No longer claiming this in reports	Evidence for Uranium on island including enriched uranium. Evidence for higher dose than stated by previous reports cited by SSD.
No uranium on coral island therefore no radon doses	No longer claiming this in reports	Evidence for Uranium and therefore Radium on coral islands in literature

The sequence of arguments

ARGUMENTS APPLICABLE TO ALL THE APPELLANTS

3.1 The arguments applicable to all the appellants fall into a number of areas:

- a) Reasonable doubt about the radiation risk model
- b) Reasonable doubt in relation to Uranium contamination at the test sites and its consequence
- c) The evidence of trans-generational effects of exposure to radiation as observed in the appellants' families
- d) The decisions of other tribunals and coroners in related cases
- e) Misleading and incorrect or inadequate fallout and rainout data

a) Reasonable Doubt about the radiation risk model

3.2 The confusion of the UT over the reasons given by the previous FtT is a consequence of the failure of the FtT to make clear that its approach to decision about causation was based upon the current radiation risk model, that of the International Commission on Radiological Protection (ICRP) also that of the BEIR VII committee of the US National Academy of Sciences (BEIR) which is based upon the former. These two risk models are effectively the same one and are based almost entirely on the Life Span Study (LSS) of the Japanese survivors of the A-Bombing of Hiroshima and Nagasaki in 1945. We shall refer to this for clarity in what follows as the ICRP model. It is the fundamental reason that the claims for pensions were refused by the SSD.

3.3 Our experts will testify that the ICRP model is not valid for exposure to internal radionuclides, such as those experienced by the veterans at the test sites. This is philosophically so since internal exposures were denied and in any event not included in any of the epidemiological studies that underpin the ICRP model. Evidence for this failure of the ICRP model is clear from theoretical publications in the peer review literature, from published reports of learned groups and British government committees, from studies of the A-Bomb victims themselves, from epidemiological studies of those exposed to internal

radionuclides, and from genetic studies of test veterans themselves, their children and grandchildren, all of which matters are covered in our expert reports.

3.4 To show causation between radiation exposure and subsequent cancer it is the current convention to begin by taking an approach to the probability of a certain defined radiation exposure causing a specific cancer in the individual veteran. As Schmitz-Feuerhake and Sawada's reports makes clear, the starting point for this, in terms of the current ICRP model, is to obtain a value for what is termed the 'dose' or 'absorbed dose' of radiation. This is a physics-based averaging concept developed in the 1950s which has great utility for external exposures, but, as they show, cannot be justified for internal exposures, where averaging is scientifically inappropriate. Nevertheless, as they point out, and as also evidenced by the statements of Hooper and Howard, the risk agencies ICRP and BEIR persist in calculating doses for those exposed to internal radionuclides on the false but convenient assumption that the energy from the internal radionuclides can be assumed to have the same biological effect as external radiation of the same energy, despite published evidence that the method is unsafe to a high degree.

3.5 The SSD has commissioned an expert from the nuclear industry, a Mr Hallard, to carry out a complicated calculation of the 'doses' to the appellants using the current conventional methodology. The Tribunal will note from Mr Hallard's report the many steps which are necessary and the complicated mathematical system of modelling used by Mr Hallard to obtain his results. Furthermore, we hope we will be forgiven for pointing out that Mr Hallard has worked for the nuclear industry most of his life and as such may not be supposed to be entirely unbiased.

3.6 In order to produce the 'dose', Mr Hallard has had to employ a process termed partition modelling. Thus, subjective assumptions are made about the amount of contamination on the ground and how it got there, about the spectrum of radionuclides which make up the contamination, about their behaviour in the environment, about their re-suspension into the air, their dissolution in water and their contamination of food, and about the rates of and processes by which at which they entered the bodies of veterans. He has had to rely on previous reports (e.g., the Australian Carter report [14] which the B&S Appellants do not accept as being accurate) and he has had to make many subjective judgements about

the mathematical coefficients which he has used to describe the sequential processes that carry the material from the ground to the inside of the veteran.

3.7 Each of the steps in the calculation involves multiplying by a partition modelling coefficient, each of which has an uncertainty associated with it. If there are 5 such coefficients, each with an uncertainty of 5-fold, then the final uncertainty is obtained by multiplying each uncertainty in each step, in other words, it is 5^5 or more than plus and minus 3000. Mr Hallard did not properly answer our question about uncertainties in his coefficients. We wanted a table with each of the coefficients and the uncertainty associated with each one. For example, Mr Hallard employed a re-suspension coefficient of 10^{-4} , though for dusty conditions generated by truck driving this can increase to 10^{-3} , a factor of ten times greater, which would have made his inhalation doses ten times higher. We will explore this issue of uncertainties under cross examination.

3.8 Mr Hallard presented his first report as the final determination of ‘dose’ and these numbers would have formed the basis for the arguments made by the SSD regarding causation. However, when the question of errors and uncertainties was put to Mr Hallard, he produced an additional report, equally complex and long, in which the ‘doses’ he had previously calculated changed and increased. Whilst we do not accept that either report is correct, even within the structure of the methodology used, we question whether the Tribunal (or anyone) can have faith in results for ‘dose’ which suddenly change following a question. Perhaps if we were to ask another question, they would change again, and so forth. This highlights a philosophical divide between the physics/ mathematics approach and the biology/epidemiology approach, which latter, our experts show, is closer to the real world.

3.9 As laid out in Professor Schmitz-Feuerhake’s report, the current ICRP model predicts a linear relation between ‘exposure dose’ and subsequent cancer (see report, para 2). That means that in the ICRP system, if the dose doubles, the probability of developing cancer is doubled. The quantity, ‘Absorbed Dose’ is simply the energy absorbed by tissue in Joules divided by the mass of the tissue in Kilograms. The units are Grays. For some kinds of exposure, notably in the case of the Appellants, alpha exposures, it is conceded by the risk models that the energy is more biologically effective owing to the higher ionizing power of the alpha particles. The alpha particle energy is then conventionally multiplied by a factor of 20 to give a new ‘equivalent dose’. The units of equivalent dose are Sieverts, and this is

generally the ‘dose’ that is referred to in these proceedings (this is accepted physics and not in dispute). The overall equivalent dose on this basis is thus the dose from gamma rays and other non-alpha sources multiplied by 1.0 plus the dose from internal alpha particles multiplied by 20. It must be appreciated that ‘dose’ in this system is a quantity averaged over large masses of tissue and we would contend that it is therefore fundamentally inappropriate for internal exposures, as laid out in the reports by Schmitz-Feuerhake, Sawada, Hooper and Howard. The relevant comparison is warming oneself in front of a fire (Joules per kilogram absorbed) with eating a red-hot coal (considered on this system to be the same dose, in Joules per kilogram absorbed). We will ask the SSD’s experts, particularly Prof Thomas, to explain how the concept of dose is applied by their ICRP model to tissues, organs and cells.

3.10 Since ‘dose’ is energy per unit mass, it is an energy density quantity. An Australian Tribunal recently made an important decision about the way in which ‘dose’ should be interpreted when assessing causation in cancer. In the case of Mahoney, Appendix 1 attached [15] and submitted to the December 15th Directions hearing, the Australian tribunal decided that it was the dose to the local tissue that was relevant in the case of a veteran who had been exposed to particles of Uranium when stationed at Hiroshima and subsequently died of colon cancer. The Tribunal accepted that the average organ ‘dose’, which is the dose calculated by the Australian equivalents of Mr Hallard, ARPANSA, was not the relevant quantity. Whilst we do not of course say that the current Tribunal should necessarily take the same approach, yet we include this as an example of the changing way in which the ICRP approach to ‘dose’ is being considered.

3.11 The historical approach (and current practice) to cancer causation, taken forward for the SSD by Dr Haylock and Dr Thomas from Mr Hallard’s ‘doses’, puts this argument on a quantitative level by comparing the ‘dose’ received by the veteran with the ‘dose’ assessed by the epidemiological lifespan studies of the Japanese A-Bomb exposed groups investigated by the Radiation Effects Research Foundation (RERF). Since there are background rates of cancer, it is necessary to calculate the probability of causation of the veteran’s cancer, on the basis of this comparison. This is done by calculating the Excess Relative Risk (ERR) for the specific cancer at the ‘dose’ the veteran received. As the SSD’s experts point out, the Probability of Causation (PC) or more accurately the Attributable Fraction (AF) is then given by the equation $PC = \frac{ERR}{1+ERR}$. The number 1 in the denominator is there because there is a background rate for all cancers and we are concerned with an increase in this rate for the

exposed veteran. This is an accepted method which is not in dispute between the Appellants and Respondents.

3.12 The comparison with the A-Bomb study results gives an excess relative risk attributable to radiation dose of about 0.45 per Sievert ([13], referred to by Schmitz-Feuerhake and the SSD's experts). That is to say, following a dose of one Sievert, there is a 45% increased probability of developing cancer as a consequence. Since the model is linear, or proportional, at a dose of 1milliSievert (1/1000th of a Sievert) the probability of developing cancer is one thousandth of this, or 0.045%. Since none of the veterans is recorded as having received much more than this dose, as conventionally assessed by the current models, it follows that they are extremely unlikely (though not impossibly so) to have developed cancer as a result of their exposures. This is the core argument of the SSD. It is the (unstated) reason that the previous FtT refused the appeals and explains why the SSD has refused such claims and appeals in the past [16-18].

3.13 In the first Statement of Case we drew attention to one way of carrying out such a calculation of the PC, by using the NIOSH-IREP radio-epidemiological program [19, 20]. In reply to a question, Dr Haylock stated that he believed this approach to be authoritative but used his own version of it, which he had developed. Using his own method, he obtained PCs for each of the individual veterans and their specific cancers.

3.14 We point out that the NIOSH-IREP approach accepts that there are significant errors associated with such causation calculation and itself includes errors in its approach. The output results from its calculations present PCs with probabilities in the various probability bands. This is because the US Senate has agreed to compensate at the 99% level of probability: that is if there is a 1% change then there is a causal link.

3.15 We note in passing that the NIOSH-IREP program (and the US authorities) have for some years included Chronic Lymphocytic Leukemia (CLL) as radiogenic and this can be inputted as a radiogenic cancer into the program. The decision by the US authorities to agree that CLL is a radiogenic disease is or should be in the Bundle. Mr Battersby's cancer claim is for CLL. Mr Haylock and Dr Thomas do not accept this US government and Centre for Disease Control decision to allow CLL as a radiogenic disease.

3.16 It should be noted, with regard to the concept of ‘reasonable doubt’ which we address in a separate section, that the use of this causation approach will always give a positive probability of causation, even if very small, so long as there is a positive Excess Relative Risk (ERR), and this will occur if (a) the cancer is listed as caused by radiation, and (b) there is thus a positive Excess Relative Risk per unit dose. This follows mathematically from the formula $PC = AF = ERR/(1+ERR)$. The only possible way that the Attributable Fraction of the probability of causation is Zero is if either the ‘dose’ is zero (ERR is zero) or if the program does not concede that the type of cancer is caused by radiation.

3.17 The question of the accuracy and relevance of the current radiation risk models has been raised in the peer review literature since the 1980s following the discovery of the child leukemia cluster at Sellafield, which could not at the time and cannot still be explained on the basis of the ICRP risk model. Prof Schmitz-Feuerhake has addressed this. Since then, there have been further examples of mismatch between the predictions of the ICRP model and observational fact as published in peer review literature. The issue was finally addressed by the UK government CERRIE committee which agreed in its main report that there were ‘uncertainties’ about the risk from internal radionuclides (and, indeed, recommended further authoritative study) albeit the quantification of the magnitude of the ‘uncertainty’ and indeed its direction was a matter of differing professional or expert opinion well beyond the fanciful, resulting in two reports being produced, a Majority and a Minority report, as detailed in the witness statement by Mr Bramhall who was a member of the CERRIE [21, 22].

3.18 One possible reason for the clear difference of opinion in the CERRIE was the determination of the Chair and Secretariat to exploit the removal from office of the commissioning Minister to whom it was responsible and to largely ignore its stated remit. Mr Bramhall’s report to the Tribunal discusses these issues. Evidence for this includes: (1) the cancellation of 3 epidemiological studies designed to examine the accuracy of the risk models for internal exposure; (2) a serious failure to consider recent research on the health effects of internal exposures, including the papers supplied by the Russian-speaking members of the European Committee on Radiation Risk, and (3) the demonstrable failure of the committee to fulfil its remit to report differences of scientific opinion in the area and recommend detailed and focused research to investigate the areas of concern so that the best evidence-based opinion could formulate new exposure limits and thus inform the lawmakers. In order to add foundation to such points, we refer to Mr Bramhall’s report (Bramhall was a member of the

committee and a co-author of the Minority report. We were going to call Mr Meacher, the Minister who set up CERRIE, but sadly he has passed away.) Bramhall will state that at least one of the studies which CERRIE was required to instigate would have supported the argument that low doses from internal contamination of the kind found on the UK atomic test sites are capable of causing significant increases in cancer in those living near the contamination. This study has since been published in the peer review literature and will be put to the experts in examination and cross-examination [23].

3.19 As detailed by our expert witnesses, Schmitz-Feuerhake, Hooper, Howard, and Sawada, concerns about the adequacy of the current risk model have been raised since 2003 by an independent organization of over 50 scientists and experts which forms the European Committee on Radiation Risk (ECRR). A new radiation risk model was constructed by this organization and published in 2003. It has been translated to French, Russian, Spanish, Czech and Japanese. An updated version of the document was published in 2010 and this extended the previous analysis to Uranium effects [24]. The ECRR 2010 report was submitted to the earlier hearings and should be in the bundle. It will be shown that Uranium contamination, which was not apparently measured by the AWRE, represents perhaps the main hazard at the test sites, a matter which UK scientists and the MoD had been informed about by US scientists in 1953 [25], an issue which we will develop below.

3.20 A statement was published by 16 eminent radiation scientists and experts, who met in Lesbos, Greece in 2009. The Lesbos Declaration [26] and see below, pointed to by both Schmitz-Feuerhake and Howard in their witness statements, drew attention to the clear evidence of the failure of the ICRP model and called for its replacement by national governments as a matter of great urgency. Here, we observe briefly that the opinions of the eminent scientists in Lesbos and members of the ECRR, two of whom appear as experts for the Appellants, cannot be dismissed as ‘fanciful’ in the context of Charles J’s decision.

3.21 The errors in the ICRP model, as outlined by our expert witnesses, can be demonstrated by both theoretical advances and epidemiological observations. A review of the former was published recently in the peer review literature by Christopher Busby ([27], referred to by Howard) and reviews are also to be found in the ECRR 2010 report (referred to by Schmitz-Feuerhake) and in the CERRIE reports (referred to by Bramhall), whilst the epidemiological proofs of the failure of the ICRP model, listed also by Prof Schmitz

Feuerhake [24], and which will be put to the SSD's experts in cross-examination, are listed below.

3.22 In our Statement of Case we asked that the SSD be put on strict proof to show the accuracy of the ICRP model on which his argument rests and asked that the Tribunal direct that he provide an expert from the National Competent Authority on this issue, Public Health England, for cross-examination. Unfortunately, neither the SSD nor any of his experts have addressed this issue or made any attempt to rebut the assertions which were made in the Statement of Case, the Memorandum which followed it, or our expert reports. We believe that this is because neither he nor they are able so to do. Nevertheless, Mr Haylock is from the National Competent Authority and since he did not address this issue in his expert report we may assume he cannot. However, both he and Dr Thomas will be given the opportunity to respond to the studies falsifying the ICRP model through cross-examination.

3.23 The recently retired Scientific Secretary of the ICRP, Dr Jack Valentin, conceded that the ICRP model could not be used for determining effects from internal radiation during a video-recorded interview with Dr Busby in Stockholm in 2009 [27] (see Bramhall's report). Valentin is the editor of the latest ICRP risk model ICRP103 2007 [13]. In the same interview he clearly stated that since he had then retired as Secretary he could agree that the ICRP had been wrong to not take into account the evidence from the effects of Chernobyl which had emerged and that could not be explained by the model, but that as Secretary he was an employee and had to do what he was told.

3.24 The following examples, detailed in our expert reports, demonstrate the failure of the current ICRP risk model in the area of internal exposure and particularly exposure to uranium:

3.24.1 Professor Schmitz-Feuerhake:

Epidemiological evidence for the failure of the ICRP model (see para. 7 of report)

a) Childhood cancer near nuclear installations – there have been numerous reports in peer-reviewed journals of increased risks of childhood leukemia near nuclear sites, in the UK, France, Germany and Switzerland. The child leukemia excesses at these sites

are between 500 and 1000 times the level expected by the ICRP model and remain unexplained by this model.

b) *Infant leukemia after Chernobyl* – a statistically significant increase in infant leukemia of children in the womb at the time of the Chernobyl nuclear accident has been reported in five different studies in peer-reviewed journals looking at rates in five different countries of Europe: again rates are between 400 and 1000 times those predicted by the ICRP model.

c) *Cancer following Chernobyl in Northern Sweden* – a study by Tondel has found increases in cancer after Chernobyl across northern Sweden; again the cancer rates when compared to dose is about 500 times what would be expected on the ICRP model.

d) *Cancer, leukemia/lymphoma and heart disease in radiation workers and flight attendants* – a variety of peer-reviewed studies since the 1970s have shown increased cancers in those occupationally exposed to radiation at doses considerably lower than those that the ICRP predicts will have any effect.

e) *Human sex ratio at birth perturbed by low doses of internal fission-product ionising radiation* – a recent study by Scherb and Voigt, in Europe, has shown ‘clear and highly statistically significant alterations in the human sex ratio at birth’ after exposure due to atomic bomb testing, Chernobyl, and near nuclear sites. This effect has been confirmed in a recent reanalysis of Hiroshima by Padmanabhan.

f) *Cancers as a result of exposure to depleted uranium* – a series of recent studies of populations exposed to DU in Iraq have shown ‘extremely high rates of congenital malformation at birth and cancer and leukemia/lymphoma in adults’. Uranium exposure was not considered by the Life Span studies on which the ICRP model is built, and is thus entirely overlooked by the model.

g) *Chernobyl effects as reported in the Russian peer-reviewed literature* – a ‘large body of peer-reviewed work’ has been published in Russian since 1996, which shows

that the effects of Chernobyl exposures are ‘massive and extremely serious’ This work has largely been ignored by the IRCP.

3.24.2 Professor Howard:

Evidence for the secondary photoelectron effect of Uranium (see section 3 of report)

Elements of high atomic number amplify, via a mechanism known as the photoelectric effect, background and other photon radiation. The absorption of natural background radiation by particles is proportional to the fourth power of their atomic number; hence Uranium, with the highest atomic number of any naturally occurring element, will demonstrate this effect to a high degree. Research by Howard and Elsaessar demonstrates the extremely high levels of ionising radiation found near Uranium nanoparticles as a result of this amplification via the photoelectron effect. This would result in a ‘dose’ to any nearby material far in excess of that to be expected simply from the radioactive decay of the Uranium itself. Since Uranium has a high chemical affinity for DNA, the ‘nearby material’ is likely to be DNA and thus the ionising effect will directly damage chromosomes, providing a plausible mechanism for the observed high toxicity of incorporated nanoparticles of materials with a high atomic number. As Howard’s statement makes clear:

‘3.5 ... This photoelectron amplification effect for elements of high atomic number like Uranium is well accepted by physicists and is real. There is unequivocal evidence also that Uranium has strong chemical affinity for DNA. The IRCP risk model does not incorporate either of these facts into its calculations of the effects of exposure to Uranium and ... the existence of such effects could plausibly explain the many anomalous genotoxic effects found in those exposed to Uranium’ (underlining added).

3.24.3 Professor Hooper:

Cancer and genotoxic effects of Uranium and depleted Uranium (see section 7 and 8 of report)

The radioactivity of Uranium is considered to be low because of its very long half-life. However, there is now strong evidence that its toxicity has been vastly underestimated due to

two main issues: firstly its chemical affinity for DNA, which means that small particles of internally ingested or inhaled Uranium will be widely distributed throughout the body, very close to the chromosomes, and will have a long retention time in the body; and secondly its high atomic number, which means there is an amplification effect due to absorption of external gamma radiation, causing ‘ionising radiation equivalent to β -radiation, capable of causing genetic damage in local tissue’. This means that Uranium exhibits, as has been shown by a number of studies of cell cultures and animals, anomalous toxicity. Yet Uranium exposure has not been measured or considered by most of the studies of exposure to and resulting dose from fallout and it is not incorporated into the ICRP risk model. In addition, studies of Uranium workers in France and Namibia and studies of populations exposed to Depleted Uranium in Iraq as well as test veterans in New Zealand, and Gulf War veterans, have shown excess risk of leukemia and cancer at levels of exposure too low for the current model to explain. As Professor Hooper concludes:

‘There are... important and major indications that for Uranium exposure and health, radiation risk science... has hitherto got it very wrong. The conventional dosimetry error appears to be upwards of 1000-fold’. (p. 4, underlining added)

3.24.4 Prof Sawada:

Studies on the Japanese Hiroshima epidemiology (section 2, 3 of report)

Prof Sawada’s report shows that the Lifespan Study (LSS) of the Japanese survivors of the atomic bombing in 1945 is epidemiologically unsafe owing to the failure to take into account the contamination of the areas by residual radioactivity from the heavy ‘black rain’ that followed the bombs. The LSS study was the basis for the ICRP radiation risk model and this continues today. The excess risks per Sievert of external exposure dose found in the Japanese survivors is the basis for the method of calculating the probability of causation carried out by NIOSH-IREP and by Dr Haylock. If it is false, the results of his calculation are in error. Prof Sawada has made a study of the non-cancer immediate radiation effects reported in the survivors at various distances from ground zero, the position directly under the detonation. The ICRP and the US authorities have always stated that since the bomb was detonated at altitude there could not have been any fallout and have therefore not included fallout in their exposure assessment. However, as a result of the sucking up of moist maritime air into the

mushroom cloud, the water which condensed at altitude, due to the cooling at altitude, fell as ‘black rain’ – a well-attested phenomenon which occurred at both Hiroshima and Nagasaki. This black rain quantitatively washed out the Uranium particles (in Nagasaki also Plutonium) and then contaminated the areas where it fell. Sawada has shown that individuals who were too far away from the detonation to receive any gamma or neutron doses from the acute (prompt) radiation nevertheless showed immediate effects of radiation damage: skin rashes, diarrhoea and hair loss. Using the relation between such effects and external gamma radiation dose in humans and mice he is able to reconstruct the doses from their internal exposures to the residual radiation, which was significant. This study shows that the ICRP risk coefficients for cancer are wildly incorrect.

3.25 The question of the safety of the ICRP risk model was addressed by the Lesvos Declaration, which was signed by 17 eminent radiation scientists from several countries. The Declaration is below. We submit that this document on its own should raise sufficient doubt about the validity of employing the ICRP risk model for defending the appeals, and we shall, with the Tribunal’s permission, read it into the record so that those listening may decide for themselves whether or not such expert opinion from 17 renowned scientists from 10 nation states is merely fanciful or worthless.

LESVOS DECLARATION

ECRR - CERI

European Committee on Radiation Risk
Comité Européenne sur le Risque de l'Irradiation

The Lesvos Declaration

6th May 2009

A. Whereas, the International Commission on Radiological Protection (ICRP) has promulgated certain risk coefficients for ionizing radiation exposure,

B. Whereas, the ICRP radiation risk coefficients are used worldwide by federal and state governmental bodies to promulgate radiation protection laws and standards for exposure to workers and the general public from waste disposal, nuclear weapons, management of contaminated land and materials, naturally occurring and technologically enhanced radioactive materials (NORM and TENORM), nuclear power plant and all stages of the nuclear fuel cycle, compensation and rehabilitation schemes, etc,

C. Whereas, the Chernobyl accident has provided the most important and indispensable opportunity to discover the yields of serious ill health following exposure to fission products and has demonstrated the inadequacy of the current ICRP risk model, especially as applied to foetal and early childhood exposures to radiation,

D. Whereas, by common consent the ICRP risk model cannot validly be applied to post-accident exposures, nor to incorporated radioactive material resulting in internal exposure,

E. Whereas, the ICRP risk model was developed before the discovery of the DNA structure and the discovery that certain radionuclides have chemical affinities for DNA, so that the concept of absorbed dose as used by ICRP cannot account for the effects of exposure to these radionuclides,

F. Whereas, the ICRP has not taken into consideration new discoveries of non-targeted effects such as genomic instability and bystander or secondary effects with regard to understanding radiation risk and particularly the spectrum of consequent illnesses,

G. Whereas, the non-cancer effects of radiation exposure may make it impossible to accurately determine the levels of cancer consequent upon exposure, because of confounding causes of death,

H. Whereas, the ICRP considers the status of its reports to be purely advisory,

I. Whereas, there is an immediate, urgent and continuing requirement for appropriate regulation of existing situations involving radioactivity, to protect the human population and the biosphere,

We the undersigned, acting in our individual capacities

1. assert that the ICRP risk coefficients are out of date and that use of these coefficients leads to radiation risks being significantly underestimated,
2. assert that employing the ICRP risk model to predict the health effects of radiation leads to errors which are at minimum 10 fold while we are aware of studies relating to certain types of exposure that suggest that the error is even greater,
3. assert that the yield of non-cancer illnesses from radiation exposure, in particular damage to the cardio-vascular, immune, central nervous and reproductive systems, is significant but as yet unquantified,
4. urge the responsible authorities, as well as all of those responsible for causing radiation exposures, to rely no longer upon the existing ICRP model in determining radiation protection standards and managing risks,
5. urge the responsible authorities and all those responsible for causing exposures, to adopt a generally precautionary approach, and in the absence of another workable and sufficiently precautionary risk model, to apply without undue delay the provisional ECRR 2003 risk model, which more accurately bounds the risks reflected by current observations,
6. demand immediate research into the health effects of incorporated radionuclides, particularly by revisiting the many historical epidemiological studies of exposed populations, including re-examination of the data from Japanese A-bomb survivors, Chernobyl and other affected territories and

independent monitoring of incorporated radioactive substances in exposed populations,

7. consider it to be a human right for individuals to know the level of radiation to which they are exposed, and also to be correctly informed as to the potential consequences of that exposure,

8. are concerned by the escalating use of radiation for medical investigation and other general applications,

9. urge significant publicly funded research into medical techniques which do not involve radiation exposures to patients.

Statements contained herein reflect the opinions of the undersigned and are not meant to reflect the positions of any institution to which we are affiliated.

Professor Yuri Bandazhevski (Belarus)

Professor Carmel Mothersill (Canada)

Dr Christos Matsoukas (Greece)

Professor Chris Busby (UK)

Professor Roza Goncharova (Belarus)

Professor Alexey Yablokov (Russian Federation)

Professor Mikhail Malko (Belarus)

Professor Shoji Sawada (Japan)

Professor Daniil Gluzman (Ukraine)

Professor Angelina Nyagu (Ukraine)

Professor Hagen Scherb (Germany)

Professor Alexey Nesterenko (Belarus)

Dr Sebastian Pflugbeil (Germany)

Professor Michel Fernex (France)

Dr Alfred Koerblein (Germany)

Professor Inge Schmitz Feuerhake (Germany)

Dr Marvin Resnikoff (USA)

Molyvos, Lesvos, Greece

b) Reasonable doubt in relation to Uranium contamination at the test sites and its consequence

3.26 It is our contention that (1) Uranium was a significant and ongoing contamination risk on the tests sites and adjacent areas, which, through inhalation and ingestion, will have caused internal exposure. Mr Hallard has agreed that this is correct. However, (2) much recent research has shown Uranium to represent a particular hazard which is not safely modelled by the ICRP risk approach. Accordingly, we devote a section to Uranium exposures at the test sites.

3.27 Although a key weapon component in enriched Uranium, the concentrations of the three Uranium isotopes which were listed in AWE 024/86 were held to be secret by the SSD. However, a declassified report from the US Rocky Flats plant gives these same data and shows that the isotope U-234 is the main hazard (Kazanjan, referred to in Hooper, [28]). Uranium was not apparently measured at the sites, nor was Tritium or Carbon-14, both radionuclides where questions have been raised through research about the safety of the application of current risk model. Prof Malcolm Hooper has provided an expert report on this issue and answered questions put by the SSD; Prof Hooper was a member (as one of us, CB, was) of the MoD Depleted Uranium Oversight Board (DUOB) [29]. Prof Howard has also provided a report, as detailed above, on the issue of Uranium particles and their anomalous genotoxicity. Mr Hallard has not calculated doses from Carbon-14 and his calculations for Tritium will be explored under cross-examination.

3.28 Uranium was the main component by mass of all the bombs tested. This may be seen by reference to the Bevis Parker Unclassified Gist document [30] disclosed for the FtT but omitted from the FtT and UT bundles, redacted copy supplied by Mr Bates for the SSD in November 2015, and also in the related Gisting Exercise report by Mr Johnston and Prof Regan of 2/8/11 [30b]. Mr Hallard also concedes this in response to a question which we posed to him. According to standard works, the quantity of Uranium contained in an atomic or thermonuclear bomb is about 1 ton per megaton yield. This is approximately seen in the Bevis Parker tables [30] which Mr Hallard employs. Mr Hallard in his reply to the question has calculated (page 135 of his revised dose report which followed the question we put to him) a total activity for Grapple Y of 4.1×10^{10} Bq. of U-238. The specific activity of U-238

is 12.4 MBq/kg or 12.4×10^6 Bq per kg. Accordingly, the mass of U-238 in the Grapple Y fallout (according to Mr Hallard's calculation based upon the Bevis Parker Gist) is $4.1 \times 10^{10} / 12.4 \times 10^6$, which is 3306 kg or 3.3 metric tons. At the same time, he has argued that the surface contamination by the U-238 is 1.6×10^{-5} Bq per square metre, which is hardly believable. If we evenly distribute the 4.1×10^{10} Bq into the 800 sq.km of Christmas Island the result is about 50 Bq per sq metre where Hallard calculates a value of 1.5×10^{-5} , thus more than 3 million times lower. Glasstone [31] states that rainout results in near quantitative precipitation of explosion residues. We will put these questions to Mr Hallard and to the other SSD experts in cross-examination.

3.29 All later surveys of Christmas Island which are in the bundle (or should be) found Uranium. These include the New Zealand McEwen Survey [32] the University of Washington Surveys [33], and the repatriation surveys [34, 34b, 35]. Measurements on Christmas Island in all these surveys detected increased levels of radiation, some of which were ascribed to Radium dials. However, though some Radium dials were found and repatriated to the UK, close examination of all the available data does not exclude the idea, mentioned by Prof Regan in the previous FtT [36] and which we share, that the apparent gamma signals which identified Radium-226 (Ra-226) may have been, or have included signals from Uranium-235 which is the main fissile component of the tests and which shares a gamma energy signal with Ra-226. Furthermore, the areas which were supposed to be contaminated by Ra-226 were very large and in particular in the New Zealand study were close to the place where the large tests had been held, though these locations were not shown to be contaminated in the later repatriation studies.

3.30 Nevertheless, in order to provide the best available data, we requested that the Tribunal ask the SSD to reveal the mass of Uranium and percentage by Uranium isotope for each of the weapons tested both in Australia (i.e., as stated in AWRE 024/86 [37]) and on Christmas Island. This the SSD has refused to do.

3.34 When a nuclear device detonates, the process is described in the contemporary standard work, Glasstone and Dolan, *The Effects of Nuclear Weapons*, [31] a source of information which is referred to by the SSD's expert Hallard and also our experts and which we agree is reliable and authoritative. Uranium was also the main component by mass of the Hiroshima and Nagasaki bombs, in the Nagasaki Plutonium bomb as a neutron reflector.

Following the detonation of these bombs, which were air bursts, it has been claimed by the US that there was no fallout or residual radiation at the test sites, the Japanese Cities. However, this is not true. We refer to Professor Sawada's evidence showing clearly that Uranium contamination resulted from rainout, from what has been termed, 'black rain'. As outlined above, the creation of this rain is a consequence of the rising fireball sucking in moist maritime air, which cools as it rises, and water condenses on the Uranium oxide nanoparticles created by the vaporisation of the weapons casings and other Uranium components. The Uranium Oxide particles colour the rain black. It is certain that at Christmas Island, surrounded by ocean with moist maritime air, a similar rainout will have occurred and indeed rain was described by a Canberra observer and in contemporary meteorological observation records. We also have submitted witness statements and documents reporting contemporary observations of heavy rain following Grapple Y from Mr Ross [2] and Flt Lt Pasquini's [39] statements. Mr Stretch, the SSD's expert meteorologist in the previous FtT has also accepted the possibility of rainout [40] as did Hogan Lovell's expert Dr Nicholson [41].

3.35 The hazard from contamination of the test sites with Uranium was raised in 1953 by the US expert Dr Karl Morgan in a meeting at Harwell. Morgan clearly pointed out that the main hazard was exposure to the isotope U-234 [25]. U-234 is concentrated in enriched Uranium during the isotope separation process. The theoretical proportion of U234 to U235 in enriched Uranium by activity is about 24 but there is evidence that the value is higher than that in enriched Uranium employed by the British from the residues in the Bevis Parker gist and the USA Rocky Flats report cited by Prof Hooper [11 and 30]. U-234 is 18,000 times more radioactive than U238 and 2900 times more radioactive than U235 [38]. We will put this question to Mr Hallard in cross-examination and generally raise it in the presentation by our experts.

3.36 The question of Uranium contamination of the test sites, both Christmas Island and Australia, is fundamental. All three Uranium isotopes are alpha emitters and were not (and could not be) measured by the gamma monitoring instruments used for radiation monitoring at the test sites, as Professor Hooper has pointed out (p.3 of report). Surveys that mentioned the presence of Uranium included that of the New Zealand National laboratory [32], which was carried out 23 years after the tests but mentioned the presence of 'natural Uranium' on Christmas Island, and the Washington University survey [33].

3.37 The decay daughter of U-234 is Th-230 which itself decays to Ra-226 [42]. This is accepted physics which is not in dispute between Appellants and Respondents. Significant quantities of Ra-226 were found in the New Zealand survey and later surveys. Gamma signals from Ra-226 are coincident with those from U-235 [again this is undisputed physics] and the issue of the identity of the radioactivity reported by the New Zealand team was questioned by Prof Regan; U-235 remained present at the time of the NZ survey, some 23 years after the tests.

3.38 All Uranium isotopes have strong chemical affinity for DNA, which is the primary target for radiation health genetic and genotoxic effects, and their anomalous genotoxicity and the mechanism for it has been outlined above and by the expert reports of Hooper, Howard and Schmitz-Feuerhake.

3.39 As Hooper has detailed in section 7 of his report, Uranium deposited through fallout and rainout from atmospheric bomb testing would be in the form of micro and nanoparticles of Uranium Oxide, as with the residues found after the use of Depleted Uranium. They would not be measurable with the survey instruments used by the MoD at the time.

3.40 As detailed by Professor Hooper, epidemiological studies of those exposed to Uranium show extremely serious and anomalous effects from the exposures. These include cancer, leukemia, heart disease, neurological effects and measurable chromosome damage. They include genetic and genomic effects in children and grandchildren.

3.41 The anomalous health effects of Depleted Uranium were discussed in the Depleted Uranium Oversight Board, a MoD sponsored body of which CB was a member. Prof Hooper was a member of this committee.

3.42 In sum, it is, we submit, clear from repeated observation and analysis of available data by a significant number of reputed scientists across the world, and as discussed by all the experts in this appeal, that:

- a) the test sites were contaminated with a range of fission products but including Uranium particulates and Uranium contamination particularly U-234;

- b) such contamination was not measured or reported, either because of technical difficulties or a perceived need for secrecy during the Cold War, but
- c) the quantities by mass of Uranium in most of the bombs was very large (about 3 tons in the largest) and fallout and rainout will have been significant.
- d) Uranium was detected in the 1983 New Zealand survey of Christmas Island but the amounts were apparently not recorded. Uranium was measured in Christmas Island in the University of Washington survey.
- e) The most radioactive Uranium isotope, U-234, was not measured in published evidence, though it must have been found in aircraft cloud sampling runs, nor were its health effects assessed even though MoD had been informed of its health hazards in 1953 [25] although AWRE were using alpha spectrometry tests on samples in the UK.
- f) Our experts Hooper and Howard submit that all Uranium carries alarmingly high genetic damage properties owing to the element's chemical affinity for DNA, the target for all radiation genotoxicity, and as a result of other mechanisms one of which involves amplification of natural background gamma radiation.
- g) The SSD's expert Hallard concedes that Uranium exposure was likely to be through inhalation of re-suspended dust from the island, from aircraft, vehicles, clothing and hair, and possible ingestion through contaminated water.
- h) Our expert reports referenced above confirm the anomalous genotoxicity of Uranium, which cannot be safely assessed through the current radiation risk models which are those employed by SSD in his defence. Finally
- i) Prof Hooper has referred to epidemiology studies of Uranium-exposed individuals, workers, miners and soldiers and DU exposed populations which show significant chromosome damage, transgenerational genetic and genomic damage and cancer, all of which are seen in the test veterans.

c) The evidence of trans-generational effects from exposure to ionizing radiation

3.43 Further evidence for exposure of the Appellants to contamination from fallout is, we contend, given by the high levels of serious health effects in the children and grandchildren of the Appellants, to which we draw the Tribunal's attention, levels which cannot be explained on any other basis than a shared exposure.

3.44 The University of Dundee has released to us the questionnaires from the 1998 Rabbitt Roff BNTVA study survey. These were reduced to total congenital malformation numbers and examined by Prof Howard who has written a Supplementary Report on this issue, which has been submitted. The final result shows that in 4419 offspring of about 1080 veterans there was an excess relative risk in the veteran children of about 10-fold and in the grandchildren of 5-fold. Prof Howard shows that the probability of this result occurring by chance is less than one in 100,000. As Howard and Schmitz-Feuerhake discuss, there have been three studies of the British Test Veterans all of which show the same very high levels of congenital diseases in offspring.

3.45 Similar transgenerational effects have been observed in the US troops deployed in the Gulf War, also exposed to Uranium particles, as detailed in the expert report of Schmitz-Feuerhake (para. 7.5).

3.46 Dr Haylock for the SSD accepts the result given by Prof Howard's analysis. The response by Dr Haylock is that the result is faulty because of a selection bias effect, that is it is a study of a group who already had joined an organisation which was campaigning on the issue of radiation and ill health. This is conceded but it is hard to see how such an effect could account for a 10-fold excess of congenital disease. And we will ask Dr Haylock in cross-examination to elaborate his thesis, and in particular to explain how he imagines these individuals joined an organisation on the basis of congenital conditions in their grandchildren which, when they joined the association in 1987, had not then been born.

d) The decisions of other tribunals and coroners on related cases

3.46 We draw attention to the case of Stuart Dyson, who was exposed to Uranium weapons fallout in the Gulf War and where evidence on the question of the cause of his fatal cancer was heard by a coroners' jury which duly found that the cancer was caused by the exposure to Uranium on the balance of probability [40], whilst we remind the Tribunal that the standard of proof required in this appeal is very much lower, as we outline at section 7 below.

3.47 We have already referred above to the Mahoney colon cancer appeal in Australia which was decided in favour of the veteran on the basis that the colon organ dose was not the correct variable to employ to assess causation but rather the particle dose to the tissue should be used. The decision is attached as Appendix 1.

e) Misleading and incorrect or inadequate fallout and rainout data

3.48 The SSD has in the previous FtT proffered statements which are crucial to the opposition to these appeals on the grounds that very few UK service personnel could have been exposed to radiation risks during or after UK atomic and nuclear tests. These statements or inferences appeared in the AB and others vs. MoD in the High Court and in the earlier FtT and UT hearings. They included:

(1) *The background doses to those at Christmas Island were lower than would have been the case if the individuals had remained in the UK.*

(2) *The doses to the individuals were either measured using film badges if they were deemed to be at risk of exposure or if they were not issued badges they could not have been exposed to more than background.*

(3) *The use of air burst tests for nuclear explosions were clean bombs which did not absorb water or terrestrial debris and therefore produce minimum local fallout.* Photographic evidence which we have obtained after disclosure requests and which we will refer to shows this was not correct.

(4) *The majority of fallout from the nuclear test shots went into the stratosphere (above the Tropopause) to be distributed globally with minimum local or regional fallout or rainout.* Meteorological interpretation of photographs [40, p. 21] and eye-witness evidence (Pasquini [39]) show this assertion is not correct. It applies to nuclear shots over 10 megatons so not to any UK tests.

(5) *The timing of shots used optimum meteorological conditions which ensured that any local fallout that may have occurred was blown offshore away from Christmas Island by low level trade winds with no risk to personnel on the Island and no risk of cumulative fallout or rainout on the island.* Contemporary meteorological data [46, 46b] and NOAA simulations [45] show that high level winds affecting the main nuclear clouds for Grapple X and Y carried the main clouds to the east with risks of fallout and rainout into onshore lower winds for up to 24 hours or more. We have supplied an expert report from Dr J. Ash on this issue [47].

(6) *Because of the choice of low level wind direction at the time of the tests the main offshore fallout and rainout sampling required was 'downwind' to the west of the Island.* This suggests a 'don't look don't find' strategy [see fallout search area in 45c] unless monitoring plans were unaware of high level winds and well-known test fallout plume patterns in the Pacific (Glasstone [31]).

(7) *Since there was no risk of local fallout from the Christmas Island tests, any local rainfall that occurred soon after test shots was coincidental due to typical local weather conditions and would not have been contaminated by radioactive material from the test.* Meteorological reports by Stretch [40] and Nicholson [41] indicate that this was not a valid assumption. Photographic images of the Grapple Y cloud indicate collapse of the lower cloud and stem into a large area around ground zero [40, p. 22]. Further contemporaneous evidence will be submitted on this point.

(8) *That the only test at Christmas Island of major significance regarding risks of fallout and rainout was Grapple Y. Minimal evidence has been considered regarding the cumulative land and adjacent marine contamination from Grapple X and the Grapple Z test shot series.* NOAA simulation exercises for all the Grapple Series indicate several shots that were likely to disperse fallout over large parts of Christmas

Island [45]. Recent disclosure of contemporary meteorological and photographic records increase concerns about apparent entrainment and complex wind conditions for most Grapple tests.

(9) *The cumulative fallout at Christmas Island was minimal as shown by the report by Clare et al [6], which does not report Uranium or Tritium testing. This is frankly hard to believe and in any case is confounded by the McDougall memo [5] that required sticky papers used for sampling airborne dust fallout to be brought in when it rained.*

(10) *There was no residual contamination of Christmas Island as shown by the 1981 New Zealand McEwen report [32]. This is not consistent with Clare [6].*

(11) *That there was no Uranium fallout contamination in the radioactive materials repatriated from Christmas Island to a landfill waste site at Teesside in 2008 as part of the UK's commitment to remediation of Christmas Island. These consignments should have been tested for alpha, beta and gamma radioactive contamination by the local authority and by the Environment Agency or other departments responsible for this material. Available records and material obtained on disclosure provide no indication of Uranium testing.*

(12) *That the only significant gamma radiation risk remaining on Christmas Island after the Grapple test series in 1957-58 came from a few Radium dials from discarded vehicles. Any such contamination would be contained within the dials and in or very near the vehicles in question.*

We will suggest to the SSD's experts that all of these statements or inferences were misleading or inadequate, or questionable at the 'reasonable doubt' level. A number of them, including the rainout, the stratosphere and the Christmas Island background dose arguments are now no longer defended by the SSD.

3.49 The background doses at Christmas Island as presented by the SSD in previous cases are based on external gamma radiation and cosmic radiation only. This is falsely compared by

the SSD with the total dose in UK which has as its main component the exposures to the radioactive gas Radon, a daughter of the decay of Uranium through its daughter Radium-226 (this is simple radiation physics and not in dispute). The SSD maintained that there is no Radon on Christmas Island but did so without supporting evidence. As both Uranium and Radium are found in significant quantities on coral atolls like Christmas Island [12] and indeed were reported to be present on Christmas Island by McEwen et al 1981 and in the Washington surveys; this is therefore a true ‘apples and pears’ comparison and fallacious argument which must be deliberate. The undeniable facts are that since the natural Uranium content of a coral island is greater than the mean content in soils in the UK, Radon was present in sufficient amounts to bring the Christmas Island background dose to greater than that at the UK.

3.50 Furthermore, background radiation measurements made in the repatriation surveys which are in the bundle show that the gamma background on the island was not dissimilar to that seen in the UK and was certainly greater than that reported by the McEwen study.

3.51 Doses calculated by Mr Hallard assume a uniform density of immediate fallout contamination on the island of 4×10^7 Bq/sq metre. This has accepted that there is rainout but we will ask Mr Hallard to explain (1) that this is immediate post detonation material for which the decay falls off very quickly and thus so do the conventional doses over a period of time. We also will ask Mr Hallard (2) why he considers the Carter data which he relies on to be accurate given that it did not contain any reference to Uranium. Following a question to him, Mr Hallard made a calculation for Uranium contamination which is not credible and which we will explore in cross-examination.

3.52 Other surveys of Christmas Island were made by the University of Washington and more recently separately by Enviro [48] and a US team [49] involved in the repatriation of radioactive material to the UK. These reports will be or should be in the FtT bundle but have not yet located them. We have carefully examined all these reports and have drawn three main conclusions. The first is that the identification of the radiation excess at various locations on the island cannot be proved to be due to Radium dials from abandoned vehicles and might include contributions from fallout and rainout residues of Uranium 235. The second is that although a very few samples were measured for Uranium, some of them did show enriched Uranium, which must have originated from a test. The third is that the

background radiation levels at Christmas Island are comparable with those in the UK according to the measurements reported by these surveys. This calls into question the earlier assertions of the SSD regarding comparisons of background doses to veterans between the UK and Christmas Island.

ARGUMENTS SPECIFIC TO THE LATE BARRY SMITH (ANNA SMITH)

3.53 The late Mr Smith's appeal is for the award of a war pension for the diagnosed condition of Pancreatic Cancer (PC) from which he died in 2009 [50].

3.54 Born in 1939, Barry Smith served with the RAF from 30th October 1959 to 1st November 1960 at Christmas Island. He was not present during any test detonation but arrived at a time when all the fallout and rainout from the previous tests had accumulated on the island surface, in its water supply and the surrounding local sea. He is thus a test case for the argument that a prompt gamma dose registered on a film badge was a pre-requisite evidence for possible causation from radiation exposure [51].

3.55 All of the considerations given so far apply to Mr Smith.

3.56 We will now take the Tribunal through the evidence supporting Mr Smith's appeal by reference to Mr Smith's reported experiences and expert scientific reports.

3.57 Mrs Smith's statement contains relevant information regarding her late husband's exposure [51]:

3.58 Mr Smith is reported to have said that he was there at the time of the clean-up following the nuclear tests. He recalled helping with the clean-up operation. He stated that his main job was as the camp barber [51].

3.59 In helping with the clean-up, he will have been exposed though inhalation and inadvertent ingestion to radioactivity accumulated on the dusty surface of the ground from the rainout and fallout from the tests. This is conceded by Mr Hallard.

3.60 However, we do not accept the calculations made by Mr Hallard regarding the exposures to Mr Smith. First, because we do not accept the basis for his use of the Carter report spectrum of fallout isotopes which failed to include Uranium from the weapons, and second because we do not accept his choice of re-suspension coefficients, and third because as a barber, Mr Smith will have cut the hair of personnel who may have visited hot areas and whose hair was highly contaminated with particles of radioactive material, mostly Uranium-238 by mass. This will have contributed to accumulation of particulates in dust in his premises (see below). We will raise these issues with Mr Hallard in cross-examination.

3.61 As camp barber Mr Smith will have been exposed to radioactivity in the form of dust and particulates in the hair of those whose hair he cut including those who will have been issued with film badges and who will have been visiting off limit radioactive zones where they might have become significantly contaminated. He will have inhaled the dust and been exposed to the radiation emitted from it in the hair of his customers. This is a clear mechanism for transferring radioactive pollution to the barber's shop [51].

3.62 He spent a lot of his free time swimming, both around the island and in the lagoon. He will have therefore been exposed to Tritium in the water. In order to provide the Tribunal with as specific evidence as possible, we asked that the Tribunal direct the SSD to provide any and all measurements made of Tritium or any other radionuclides in the lagoon. The SSD replied that there were no such measurements. It is therefore impossible for the SSD to maintain that the water was not contaminated, and indeed the evidence that it may have been, as detailed in 3.27 above, is neither fanciful nor worthless.

3.63 He went fishing and ate fish that he caught. The SSD's reliance in the previous FtT on the method used to determine radioactivity in the fish is erroneous for reasons given above, that pure alpha and beta emitters could not be detected by the method (this is not in dispute). The Washington University survey detected Uranium in a fish caught on the coast of Christmas Island [33].

3.65 The scientific and medical community accepts that ionizing radiation is a cause of Pancreatic Cancer. The disease was elevated in the Japanese LSS study [52] whilst the 15-country nuclear workers study [53] gives a linear interpolated excess relative risk of 1.2 at 100mSv. The excess risk at 5mSv is 14%. That means that the risk is more than doubled at a

dose, as conventionally assessed, of 100mSv. The risk is elevated in the Cardis study at doses as low as 5mSv [53]. We will put these data to Dr Haylock and Dr Thomas in cross-examination.

3.66 The NIOSH IREP median output for Barry Smith and Pancreatic cancer is 0.04% at an alpha dose of 5mSv. We will ask Dr Haylock to comment on this in cross-examination. The results are positive, which means that even at this dose the calculation based on ICRP/BEIR states that there is a finite positive probability that his cancer was caused by his exposure. There is no ‘doubt’ whatever, even using the incorrect and unsafe radiation risk model, that his cancer could have been caused by his exposure. Dr Haylock calculates a small but positive probability of causation.

3.67 Using the Cardis excess risk at 5mSv from the 15-country nuclear workers study $PC = 0.14 / 1.14 = 0.123$ or 12.3%. This will be explored with Dr Haylock in cross-examination.

3.68 Using the values derived from the other Uranium studies quoted and discussed by Prof Hooper, the PC is greater than 50% and it is more probable than not that Mr Smith’s cancer was caused by his exposures to internal Uranium and other internal exposures resulting from his work as a barber, his inhalation of re-suspended dust, his swimming and his eating and drinking contaminated fish and water. This will be explored with Dr Haylock and Prof Thomas in cross-examination.

3.69 In summary, the well-researched and peer-reviewed science our experts have presented shows that there can be no reasonable doubt that Mr Smith’s PC was likely to have been caused by his exposure to ionizing radiation during his enforced service on Christmas Island. That, however, is not the appropriate test in law for a war pension but, indeed, considerably exceeds those requirements.

3.70 We now deal with the meteorology applicable to the Christmas Island tests, and expressly with the size and position of the Grapple Y cloud and other tests at Christmas Island (see also 2.21 above). The matter is part of the Expert Report of Dr Ash [47].

3.70.1 The SSD maintains that no shots (i.e. test explosions) were fired unless winds were blowing safely away from inhabited areas. Examination of NOAA HYSPLIT

computer analysis for the Christmas Island shots in 2010 [45] showed that even though ground level winds may have been offshore or diagonally offshore, upper level winds on at least three of the Grapple tests were in the opposite direction – to the east. These major wind shifts at different altitudes were subsequently confirmed by contemporary meteorological records [46, 46b] and more recent re-interpretation [40, 41, 47].

3.70.2 The size of the large Grapple Y cloud was reported by eye witnesses and the Sniffer aircraft and essentially covered the entire island [2, 39, 40, 45b, 45c]. Although the lower level cloud stem was blown out to sea to the west and north-west, the upper winds took the main cloud and fallout plume to the east [45b, 45c]. Any fallout or precipitation (rainout) from the cloud as it drifted east were likely to descend into the lower onshore winds from the south east to blow back across the island [45b]. Similar upper wind conditions applied for the Grapple X test.

3.70.3 Rainfall below the Grapple Y cloud was reported by Sniffer aircraft observer Joe Pasquini [39] and at ground level a distance by the meteorological station on Christmas Island [40, 41]. Rainfall was also reported by the Met station after Grapple Z1 (Pennant) [46b]. Mr Johnston's map [45c] shows measurements of Plutonium fallout in the vicinity of the main camp after that lower altitude test.

3.70.4 Rainfall containing Uranium particulates is to be expected on the basis of known reported behaviour of thermonuclear and atomic weapons as described in standard works, e.g., by Glasstone [31]. The air masses were laden with water which was maritime and saturated and these will have been drawn up into the rising mushroom cloud structure where at altitude due to the adiabatic lapse rate the water will have condensed preferentially around the Uranium micronuclei to fall as rain. Prof Sawada discusses the mechanism in his report as it applied to Hiroshima and Nagasaki.

3.70.5 In an effort to provide the Tribunal with the best actual evidence, Flt Lt Joe Pasquini previously [39] testified that he saw the actual fall out cloud from his Canberra sniffer aircraft, observed the cloud bulge the tropopause, and saw precipitation descend from the cloud; his testimony is supported by photographs. All

such primary evidence was, however, disregarded by the SSD, a point which Group Capt Ades' made clear in the speaking note he was forced to withdraw before the UT.

3.70.6 We provide a statements from an eyewitness, the late Mr Ross, who stated he witnessed heavy rain after Grapple Y [2].

3.70.7 The SSD expert, Mr Hallard, has accepted that there is a possibility of rainout, and this is a change of position for the SSD from the earlier FtT. However, rainout is stated by Glasstone to quantitatively precipitate material from the clouds and so the choice of average contamination made by Mr Hallard cannot apply to locations where it rained; in such locations the immediate surface concentration of radioactivity will be many millions of times higher than assumed by Mr Hallard. The statement of the late Mr Ross reveals that in his case there was significant panic among the radiation specialists who approached his team wearing full protective gear [2].

3.71 We do not accept the doses calculated by Mr Hallard for reasons given above. We do, however accept that as conventionally calculated they are unlikely to be greater than a few tens of mSv. We will investigate this with the SSD's experts in cross-examination.

3.72 Such a dose will result in a small but positive Probability of Causation for Pancreatic cancer using the conventional ICRP approach of NIOSH-IREP and as employed by Dr Haylock.

3.73 However as argued above, and demonstrated by considerable research and epidemiology, as outlined by our experts witnesses, the ICRP approach to calculating a PC is not safe. The error factor as presented by Prof Hooper, based on the French Uranium worker studies and by Prof Schmitz-Feuerhake on the basis of a significant number of published papers is of the order of 1000-fold or greater. For genetic damage, which is a precursor to cancer, Prof Schmitz Feuehake and co-workers have recently shown in a peer reviewed paper submitted by her, that based on studies of Chernobyl, and also nuclear workers and test veterans, the error in the ICRP risk model is about 1000-fold. This is also supported by the results obtained by Prof Howard for the Dundee data on the British veterans offspring.

3.74 As decided by the Australian Tribunal in the case of Mr Mahoney's colon cancer, and the coroner jury in the case of Mr Dyson, it is the dose to the local tissue where the radioactive particle is lodged that determines the risk of cancer rather than the whole body ICRP average effective dose calculated by Mr Hallard. Thus a biologically plausible mechanism here in the case of Mr Smith is that he inhaled sub-micron diameter Uranium particles, present as re-suspended dust in his barber shop, or in the hair he cut, which were translocated through the lung via the tracheobronchial lymph nodes to the lymphatic system and thence to the bloodstream, and following metabolic transfer through the liver were ejected by the gall bladder into the joint pancreatic/ gall bladder common bile duct where one of them became trapped for sufficient time to give a high local dose to local pancreatic tissue or the duct wall itself, which then invaded the pancreas. We will ask Mr Hallard under cross-examination to agree that the alpha dose alone in one year will have been more than 1000mSv without any considerations of Uranium anomalous genotoxicity as discussed by Prof Hooper and Prof Howard.

3.75 Mr Smith, an intelligent and thinking man, was aware of the problem of Uranium particles and the failure of the ICRP model for internal exposures. He sent a letter to the SSD attaching Prof Sawada's earlier 2009 published paper on the issue. Despite having posted it recorded delivery, the SSD claimed not to have received it, which is hardly credible. It was used as a justification for not hearing his appeal. He died three weeks later. We mention this as another example of the unfair way in which the SSD has throughout these appeals blocked access to relevant materials, refused to release important information, taken documents out from bundles and generally acted in a very underhand way in his approach to justice for these veterans.

ARGUMENTS SPECIFIC TO THE LATE DON BATTERSBY (KAY BATTERSBY)

3.76 All of the general considerations above apply to Mr Battersby.

3.77 Don Battersby was born in 1936 and served in the RAF in Maralinga Australia for 6 months in 1956 during the Operation Buffalo tests. He observed 4 of the tests from a distance of 4.5 miles [54].

3.78 In 2005 he was diagnosed with Chronic Lymphatic Leukemia (CLL), the condition for which he claimed a pension in 2011.

3.79 In 2013, shortly after his appeal against the SSD's decision to refuse a pension for CLL, he was diagnosed with Pancreatic cancer, the same disease which was the cause of death of Barry Smith, another appellant Mr D Williams (Mrs E Williams) and now, very recently, a further appellant, Mr T Butler. The fact that four of the 13 appeals veterans in the previous case developed the same cancer is itself a powerful argument that their exposures caused the cancer. The SSD allowed Mr Battersby's Pension in the case of the Pancreatic cancer. The SSD therefore accepted that Mr Battersby's radiation exposure caused his Pancreatic cancer. It would also therefore have been sufficient to cause his CLL, except that the SSD does not accept that CLL is radiogenic. This may focus the issue on reasonable doubt about the radiogenicity of CLL, which is discussed by Prof Howard in his report.

3.80 Mr Battersby was an aircraft mechanic and one job he had was cleaning off the aircraft that had flown through the radioactive dust clouds. He did this on four occasions for each of the tests he observed. The cleaning was carried out with buckets of water and a cloth. No protective overalls, gloves or masks were worn. He wore white nylon overalls and used bare hands. The cleaning was carried out on the same day or the day following the tests [54].

3.81 After cleaning the aircraft, he showered and was measured with a Geiger counter. He would often have to shower up to five times before the Geiger result was at an unspecified 'safe limit' [54].

3.82 He believes, (with some justification) that he would have inadvertently ingested and inhaled 'considerable amounts of radiation' at this point, not least because his task involved cleaning particulate contamination in the form of dust off highly contaminated aircraft using only rudimentary equipment and with no protective clothing whatsoever [54].

3.83 The late Mr Battersby stated that he helped to build a makeshift village to see what effects the later bombs would have on it. He returned to this site after the detonations three times to realign structures and carry out further work. No protective clothing was issued. He visited the ground zero hot spot with no protective clothing and owing to the heat wore only shorts with no shirt [54].

3.84 He explains that the canteen was demountable and was collapsed when a bomb was detonated so that the blast did not wreck the structure. Thus the blast, which carried radioactive dust, passed across the canteen area and contaminated the food, drink and utensils [54].

3.85 He was provided with some kind of dosimeter which he clipped to his shorts, but states that he lost it. Although he was issued with another one, there is no record of his dosimeter dose. This would, in any case, have been an external gamma dose and would not have registered alpha dose nor most of the beta doses.

3.86 It is therefore unarguable that in the dry and dusty conditions of Maralinga and given his activities he will have become contaminated with alpha emitters including Plutonium and Uranium. The matter of Uranium-234 and Uranium-238 discussed above applies particularly to Mr Battersby.

3.87 The surface contamination of aircraft which flew through the radioactive clouds at Maralinga for Operation Buffalo will have been recorded by the MoD or others at the time. We are able to refer the Tribunal to measurements made on aircraft which flew through the Christmas Island nuclear clouds and to measurements from subsequent sampling activities by 543 Sqn aircraft in the 1960s and 70s.

3.88 Mr Hallard has made various assumptions about Mr Battersby's exposures which we do not accept for reasons already given. However, we believe that Mr Battersby's dose was not greater than 100mSv as conventionally calculated.

3.83 Mr Battersby's appeal before you is against the decision by the SSD to refuse a pension for the condition CLL. The reason given is that CLL is not considered by the MoD to be a radiogenic disease, notwithstanding the fact that since 2011, the US Department of Health and Human Services (DHHS) has accepted (as has the Veterans Administration) CLL as a radiogenic cancer. The MoD appears to base its refusal on the argument that there was no significant excess CLL in the Japanese A-Bomb lifespan study group. Whilst the Tribunal might agree that, in the light of the reaffirmation of the standard of proof of causation by Mr Justice Charles and the obvious fact that the US Government's decision is based on evidence

more than fanciful, the SSD's decision is obdurate, we deal here with the Japanese study. We hope, however, that others will see the SSD's decision as utterly inexplicable in the light of the very close, long-standing and continuing UK-US relationship in nuclear weapons.

3.83.1 The limitations of the Japanese A-Bomb studies for internal exposures have been presented above and discussed by Prof Sawada and Prof Schmitz-Feuerhake in their expert reports and responses to questions. In particular, the control group who were not in city at the time of the bomb (NIC) were exposed to internal radioactivity from Uranium and other radionuclides as a result of the black rain [4]. They are thus not a safe control group.

3.83.2 Nevertheless, in the last 10 years other studies carried out on internally exposed groups, mainly those exposed after Chernobyl, have shown a statistically significant excess risk of CLL. Professor Howard has written on this issue on his expert report and has concluded that the US government is correct to include CLL as a radiogenic disease.

3.83.3 The US Congress has admitted CLL into the radioepidemiology NIOSH IREP calculation system; that is to say it is now accepted as an outcome of previous exposures.

3.83.4 We have inputted Mr Battersby's dose of 10mSv assumed by the previous FtT into the NIOSH-IREP computer. The result shows a 20.5% probability of causation at the 99th percentile, 0.4% at the 50th percentile. Mr Haylock, on the other hand, though he has agreed, upon questioning, that the NIOSH-IREP program is authoritative, has concluded that the Probability of Causation for CLL in the case of Mr Battersby is zero. This is a consequence of Mr Haylock's subjective decision to disregard the published evidence and assume that CLL is not radiogenic. We will ask Mr Haylock about this in cross-examination.

3.83.5 Of course, the NIOSH IREP program makes its calculation on the basis of the Japanese LSS epidemiology results which our experts, and the evidence, shows to be incorrect. Thus we only record these results to show that the baseline methodology using the ICRP approach still shows a finite positive probability of causation.

3.83.6 In a response to a Freedom of Information request made by Gp Capt Ades, the MoD stated that the question of the radiogenicity of CLL had last been assessed in 2003 and would be reassessed in time for this FtT in view of the new evidence. It seems they have not done this.

3.84 Mr Battersby's twins, born shortly after his return to England, were badly deformed and died shortly after birth [55]. He stated that his two later children suffered health problems that he believes are associated with his prior exposures. Professor Howard and Professor Hooper both draw attention to studies which have shown a significantly high degree of congenital illnesses in veterans and we submit therefore that the fatal birth defects in Mr Battersby's first children represent evidence that he, as well as other veterans, was exposed to radioactivity at the Test sites which caused genetic damage to his sperm. We make the point that such sad familial illness and deaths would be statistically improbable without a common cause and suggest that the most likely common cause is Mr Battersby's exposure at Maralinga. We explain this further below and also refer to Prof Howard's report on the Dundee genetic data.

3.85 Prof Schmitz-Feuerhake, our expert witness, has published a recent paper (with Dr Busby and Dr Pflugbeil of the German Society for Radioprotection) which employs the post-Chernobyl data to find that the ICRP model is incorrect for genetic damage effects by a factor of greater than 1000-fold. The paper was submitted by Prof Schmitz Feuerhake and should be in the bundle [56]. Dr Schmitz-Feuerhake's evidence is that congenital malformations occurred in Chernobyl-affected populations at ICRP doses of less than 1mSv. The paper also reviews evidence from the nuclear test veterans studies and shows that these also support the view that the Japanese data was improperly analysed.

3.86 The Tribunal judge has accepted that evidence of congenital effects in the offspring of the veterans may be used as evidence of prior exposure. For this reason he made a 3rd Party Direction for the University of Dundee to release the 1999 British Nuclear Test Veteran Association (BNTVA) questionnaires from the BNTVA/Rabbitt Roff study. These were eventually obtained in mid-March and have been reduced to numbers of children and grandchildren born after service at the test sites of 1080 veterans and the numbers of congenital effects in this population of 4419 offspring. The results are presented in a

Supplementary report by Prof Howard who is an expert in this area. They show an approximately 10-fold excess risk of major congenital malformations compared with the expected number in all offspring (children and grandchildren). This is highly statistically significant and could not have occurred by chance. They show that the veterans' children and grandchildren had a significantly high level (about 10 times the expected number) of congenital diseases. These could only have been caused by radiation exposures of the fathers at the test sites since this group had nothing else in common. Mr Battersby was one who suffered from this effect.

THE PROBABILITY OF PANCREATIC CANCER OCCURRING IN APPELLANTS OTHER THAN FROM A COMMON CAUSE

3.87 Four of the 13 appellants in the appeals (i.e., those represented by Hogan Lovells in the previous appeals for whom CB provided expert evidence) died from Pancreatic Cancer. This combined event has a vanishingly low probability which can be calculated and which in itself points to a shared experience as the cause of the disease. We will ask Dr Haylock to provide this calculation.

3.88 The probability of four events all giving the same result is merely $P(1)$ times $P(2)$ times $P(3)$ times $P(4)$ as long as the events are independent. Thus the chance of throwing four sixes on consecutive throws of an unbiased die is $1/6 \times 1/6 \times 1/6 \times 1/6 = 1/1296$. The same result obtains for four separate unbiased dice thrown all at once.

3.89 This approach can be applied to Mr Smith, Mr Williams, Mr Battersby and Mr Butler. Pancreatic Cancer (PC) is not a common disease. The P values are merely the cumulative probability over the lifespan of the individuals that they will die from PC at the age they did. The death rates are available from England and Wales national data [57]. One of us, CB, has carried out this calculation and will gladly do so for the Tribunal in the hearings, unless it is ruled that making such a calculation represents giving expert evidence. He states that the result is around 1 in 10,000,000. We will ask Mr Haylock, who is a mathematician, to employ national death rate data by age group (available from the Office for National Statistics) to carry out this calculation showing the number he believes is correct and support this number under cross-examination.

3.90 It is thus vanishingly unlikely that these four individuals, from 13 appellants, will have died from PC unless some factor common to all 4 interfered with the normal rules of probability. Since cancer is not a communicable disease, and is believed to be the consequence of a prior exposure to some carcinogenic contaminant, and the only life event which these three individuals, Smith, Battersby, Williams and Butler shared was presence at a Test site where there was radioactive contamination, it follows with a very high degree of certainty that it was this that was the cause of their deaths from PC.

3.91 Since Smith was not exposed to any prompt gamma radiation but only to internal contamination, it follows that it was the internal contamination in all four cases that was the most likely cause of the pancreatic cancer.

4

Stepping Stones

List of Issues to be determined by the Tribunal

Possibilities (P) and Certainties (C)

Draft for list of Agreed Issues

4.1. Following the valuable suggestion of Charles J about approaching this complex scientific and epidemiological field we provide our view of the sequence of arguments and those parts which we believe are certainties (C), and those which we believe are possibilities (P). We have labelled as (P) those items we believe to be certainties but where we believe the SSD will disagree.

Issue 1: The risk model and no safe dose

4.2 (P) There is sufficient doubt that the current radiation risk model, that of the ICRP, which is employed to determine probability of causation following exposure to ionising radiation, is safe in its application to internal exposure to the radionuclides created by the tests. The true risk from such exposures is very much greater than calculated by the methods of the ICRP model.

4.3 (C) There is evidence from studies by Professor Sawada that the basis for the ICRP model, the Japanese Life Span Study is wrong (see below).

4.4 (P) The concept of Absorbed Dose as calculated by ICRP is unsafe for applying to internal exposures for various reasons.

4.5 (C) Nevertheless the baseline minimum risk from exposure to radiation can be determined from the ICRP model using ICRP dose and the percentage probability of causation of cancer from a radioepidemiological program NIOSH-IREP developed in the USA by the Centre for Disease Control which is available on the internet.

4.6 (C) The result of entering details of Mr Battersby and Mr Smith both give positive finite probabilities of causation so long as they were individually exposed to radioactivity from the tests.

4.7 (P) The real probability is far greater than this computation shows due to the error in the ICRP model for internal exposures.

4.8 (C) There is theoretical and epidemiological evidence of fact that our experts state is so.

4.9 (C) Discussion of this internal exposure issue was the subject of the discussions of the Committee Examining Radiation Risk from Internal Emitters (CERRIE).

4.10. (C) The CERRIE Committee failed to agree a final report as there were disputes between experts. The Committee did not fulfil its remit as the Minister Michael Meacher that founded it was removed from Office and replaced with Elliott Morley who closed the committee down. Nevertheless, there was agreement that uncertainties in internal exposure risk model could be as much as 10-fold.

4.11 (C) The Lesvos Declaration of 17 eminent experts in the field of internal exposures agreed that the ICRP model was unsafe and must be abandoned.

4.12 (C) The ex-Secretary of the ICRP in an interview with C Busby agreed that the errors in the ICRP model for internal exposures could be as high as two orders of magnitude (up to 500-fold) for certain internal exposures.

4.13 (C) There is epidemiological evidence presented by our experts and in the literature from child leukemia and other studies that the errors in the ICRP model can be as high as 1000-fold or more. That is, there are 1000 times or more cancers than is predicted by the ICRP dose.

4.14 (C) There is epidemiological evidence from Chernobyl effects that the ICRP model for congenital disease is incorrect by a factor of about 1000-fold.

4.15 (C) There is epidemiological evidence from 3 different peer reviewed papers that the offspring of the nuclear tests veterans suffered an approximately 10-fold excess risk of congenital malformations.

4.16 (C) The Dundee data presented by Dr Howard supports a 20-fold excess (possibly because the larger earlier cohort contained veterans who had larger doses and therefore died earlier). We say that this is objective evidence of significant genetic exposures in the fathers.

4.17 (C) The New Zealand chromosome study of Wahab et al [1] showed that the New Zealand veterans suffered significant excess chromosome damage, supporting the studies of congenital disease in the children of veterans and at doses which were less than 10mSv as conventionally calculated by the ICRP methodology employed by Mr Hallard. Such chromosome damage is also seen in others exposed to Uranium, which was the main contaminant by mass at the test sites. Prof Hooper has written on this issue in his report. Prof Schmitz Feuerhake has referred to her genetic paper which shows genetic damage at internal doses below 1mSv.

4.18 (C) The basis of the ICRP model is the Lifespan Study of the Japanese A-Bomb survivors.

4.19 (P) There is sufficient doubt that this is safe evidence to base a model of internal exposures on since Hiroshima was contaminated with residual radiation containing fission

products and Uranium from rainout, called 'black rain'. This evidence is presented by Prof Sawada in his report.

4.20 (C) The control group for the LSS study were therefore exposed to residual radiation and Uranium and therefore the entire study is confounded and cannot be used to assess risk from internal radiation exposures.

4.21 (P) Calculations of causation for those exposed to internal fission products and Uranium are better carried out using the risk model of the European Committee on Radiation Risk. The SSD could have employed the ECRR dose conversion coefficients published in ECRR 2010 and on the ECRR website, www.euradcom.eu but stated that 'there was no other model to the ICRP model available'.

4.22 (C) There is no safe dose of radiation and both the ECRR and ICRP models agree on this. All exposures to radiation carry a finite risk for genetic damage and cancer.

Issue 2: Contamination and exposures at the Test sites

4.23 (P) The tests at Christmas Island (Smith) and Maralinga (Battersby) produced fallout and (at Christmas Island) rainout of nanoparticles particles of Uranium-235, Uranium-238 and large amounts of Uranium-234 which were deposited on the ground at both test sites. This is now accepted as possible by the SSD. The quantity of Uranium in the Grapple Y Bomb fallout was more than 3 tonnes on the basis of Mr Hallard's interpretation of the Gisted data. The SSD has refused to release the true quantities.

4.24 (C) The bombs were all made from materials which included a combination of Uranium isotopes which would have been vaporised by the detonations and the unfissioned Uranium (more than 50% according to Mr Hallard; we would argue more than 75%) would have fallen to earth locally in rain and as fallout nanoparticles. The gisted data supports a fallout quantity in the case of Grapple Y in excess of 3 tonnes of Uranium-238. It is simple arithmetic to show that this makes about 600,000,000,000,000,000 Uranium oxide particles of 1 micron diameter (3×10^{17}).

4.25 (P) The position of the clouds and the extent of fallout and rainout are areas of contention. The SSD have now agreed that the fact that high levels winds will have moved the detonation clouds back across Christmas Island makes the previous 'safely out to sea' arguments wrong.

4.24 (P) The extent of and existence of rainout at Christmas Island remains an area of dispute but is largely overtaken by the new approach of the SSD's expert Mr Hallard who has included rainout and fallout and decided on a 'Maximum contamination' scenario.

4.25 (P) We do not accept Mr Hallard's calculations as correct as he has made many assumptions which we cannot agree with, principally the re-suspension coefficient in dusty conditions.

4.26 (P) We do not agree with Mr Hallard's calculation of the surface contamination by Uranium-238 which we feel is wildly in error and which we will revisit in cross-examination.

4.27 (C) Although this does not appear to be a platform that the SSD continues to employ, for the record, and in case he does, the background radiation dose to individuals stationed at Christmas Island was not lower than it would have been if the individuals had remained in the UK since Christmas Island contained natural Uranium and therefore the gas Radon which represents the main component of the background dose in the UK.

4.28 (C) There is sufficient doubt over the claim made in previous hearings that Christmas Island was not contaminated with Uranium and Radium from the tests.

4.29 (C) Other serious and unmeasured radionuclides include Tritium which will have contaminated drinking water and Carbon-14, both elements which are incorporated into the body [42]. Neither of these has been adequately (or at all) included in Mr Hallard's calculations.

Issue 3: Uranium: the missing exposure

4.30 (C) Uranium has anomalous genotoxicity due to photoelectron amplification of natural background radiation. Prof Howard and Prof Hooper provide evidence about this issue, which includes the following arguments:

4.31 (C) Uranium has a high chemical affinity for DNA and causes chromosome damage which cannot be explained by the ICRP model.

4.32 (C) In terms of mass, Uranium was the largest exposure on the test sites both at Maralinga and at Christmas Island.

4.33 (C) No systematic measurements of Uranium at Christmas Island either were made or are available.

4.34 (C) Uranium being an alpha emitter cannot be measured by Geiger counters and was not measured in the monitoring that was carried out at Christmas Island.

4.35 (C) Internal Uranium exposures at ICRP-assessed low doses cause chromosome damage.

4.36 (C) Epidemiological studies of low doses of internal Uranium in workers and groundwater studies show significant excess risk of cancer and leukemia at levels where the ICRP model predicts no measurable effect, as detailed in expert reports by Hooper and Schmitz-Feuerhake.

Issue 4: The appellants' cancers

4.37 (C) Battersby was stationed at the test site in Maralinga during Operation Buffalo and among other tasks wiped down aeroplanes that had flown through the radioactive clouds.

4.38 (C) Smith was stationed at Christmas Island from 1959 to 1960. He was the camp barber.

4.39 (C) Pancreatic Cancer (Smith) can be caused by exposures to radiation and internal radioactive contamination.

4.40 (C) Chronic Lymphocytic leukemia (Battersby) can be caused by exposure to radiation and internal radioactive exposures.

Issue 5: Genetic damage in veterans and their offspring

4.41 (C) Inductive retrospective evidence of exposure of the veterans exists in the fact that there was a significantly high level of congenital disease in the offspring, children and grandchildren and also in a significantly high level of miscarriages in their wives.

4.42 (C) There is peer-reviewed evidence of genetic damage in some New Zealand veterans indicated by chromosome damage.

4.43 (C) There is indicative peer-reviewed published evidence that this genetic damage could be the result of exposures to Uranium.

4.44 (C) There is evidence obtained from the University of Dundee disclosures that the BNTVA veterans children and grandchildren suffered 10-fold excess of major congenital effects.

4.45 (C) Battersby's offspring suffered major congenital damage effects.

Issue 6: The appellants' exposures

4.46 (P) Smith will have been exposed through inhalation of re-suspended contaminated particulates and uranium in dust which had accumulated in surface material as a result of the several tests which had preceded his arrival, and particularly from inhaled dust from the hair of those whose hair he cut in his occupation as the haircutter on Christmas Island, some of whom will have been present during the tests.

4.47 (P+) Smith will have been contaminated by ingestion of water and eating fish, both containing Tritium and the latter Carbon-14, which will have contaminated the island and fresh water due to tests which had preceded his arrival.

4.48 (P+) Battersby will have been contaminated by inhalation and inadvertent ingestion of particulates as a consequence of his job cleaning contaminated aircraft.

4.49 (P) Battersby will have been contaminated by inhalation and inadvertent ingestion of contaminated dust from the Maralinga site

Issue 7: Pancreatic Cancer and probability

4.50 (C) Both Battersby and Smith died from pancreatic cancer as did two other of the original 13 veterans in the case, Williams. The probability of this combined event occurring without a shared antecedent cause is less than 1 in 10,000,000.

4.51 (P+) This alone links the veterans together in terms of some previous shared exposure to a common cause which can only be presence at the Test sites and exposures to carcinogenic material.

Sequential presentation of argument

4.52 To assist the Tribunal, the SSD and all interested parties, we have created Tables for each the Appellants we represent showing the sequence of argument we maintain results in the conclusion that there is sufficient doubt raised in the terms of the Article 41 test as interpreted by the UT. Evidence for each specific item in the chain is referred to in the Statement of Claim and/or has been given in the expert reports and responses, and will be given though examination and cross examination of expert witnesses and witnesses of fact.

4.53 Table of argument for Battersby

Step	Item	Poss/ Cert
1	DB was stationed at Maralinga during the Buffalo operations and cleaned down contaminated aircraft	C
2	DB will have inhaled and inadvertently ingested radionuclide particles and particles of Uranium 238, Uranium 235 and particularly Uranium 234 from the aeroplanes	C
3	Merely by being there he will have inhaled and inadvertently ingested all the above which will have been re-suspended into air from ground contamination by well described and accepted physical mechanisms	C
4	The Uraniums represent the largest fraction of the fallout and aircraft contamination by mass.	C
5	U-234 represents the largest fraction of the Uranium by activity and is present in Enriched Uranium due to its low mass and natural activity ratio with U-238	C
6	Research shows that Uranium binds to DNA and has anomalous excess radiogenetic characteristics. It causes genetic damage at very low doses as conventionally assessed by the ICRP model. MoD had been warned about the danger from U-234 in bomb residues by the US in 1953 but it was not (apparently) measured nor assessed. The Uraniums are alpha emitters and do not register dose on film badges nor monitoring equipment	C
7	Genetic damage from Uranium or other radionuclides is shown by chromosome defects. These were found in the lymphocytes of New Zealand test veterans and also in Namibian Uranium miners and Gulf War veterans with measured Uranium in their urine.	C
8	Genetic damage is shown by congenital defects in offspring. This was found in three studies of UK test veterans. DB's first children were born	C

	with fatal birth defects. Genetic damage and cancer was found in Iraq in individuals with excess Uranium in hair.	
9	DB later developed Chronic lymphocytic leukemia, CLL, the subject of the appeal.	C
10	Though CLL was not elevated in the Japanese studies and was until recently held to not be radiogenic, several studies of others exposed to internal radionuclides show excess risk.	
11	CLL is caused by exposure to ionising radiation from internal exposures	P+
12	On the question of dose necessary to cause CLL and other cancers, there is a dispute among experts.	C
13	The error factor in the current assessment of risk from internal Uranium is 1000.	P
14	DB eventually dies from pancreatic cancer. Two other vets in the FtT also died from pancreatic cancer. The probability of this occurring in these three is less than 1 in 100,000. This shows that they all three shared a common genetic damage exposure which can only have been the test site radioactivity.	C
15	The error factor in the assessment of risk from other internal radionuclides is upwards of 300.	P
16	The US Centre for Disease Control and the US government have accepted that CLL is a radiogenic disease.	C
17	There is sufficient evidence to raise doubt about the assertion that DB's CLL was not caused by his exposures	C
18	DB's wife gave birth to twins shortly after his return from service and these children died at birth from congenital effects. The levels of congenital disease in the offspring of veterans in general was significantly high	C

4.54 Table of Argument for Barry Smith

1	BS was stationed at Christmas Island in 1959 after the last of the British tests had occurred.	C
2	By that time Christmas Island was contaminated with the accumulated material from all the British nuclear tests.	C
3	All of the bombs tested contained large masses, up to several tons of Uranium including U-238, U-235 and U-234.	C
4	The bombs tested contained kilogram masses of Plutonium	C
5	All these radionuclides are alpha emitters and cannot be measured by film badges or Geiger counters used to survey for contamination	C
6	Owing to the nature of a nuclear explosion, these Uranioms and Plutoniums will have been present as nanoparticles	C
7	The nanoparticles of U and Pu will have contaminated the Island to varying levels from fallout and rainout. Uranium was measured on the island in 1983. A decay product of U-234 is Radium 226, which was detected in significant quantities in 1983.	C
8	The nanoparticles of U and Pu will have been redistributed over the whole island as a consequence of wind-blown dust and physical re-suspension.	C
9	The air over the whole of Christmas Island will have contained nanoparticles of Pu and U, re-suspended from material on the ground by well-known and described physical mechanisms and available for inhalation and inadvertent ingestion.	C
10	Every individual on the island will have had contaminated dust in their hair.	P+
11	BS was the island hairdresser and cut the hair of those individuals who had badges and visited the more contaminated areas. His hairdressing salon will have had cut contaminated hair on the ground and he will have swept it up	P+

	and cleaned the room regularly, generating quantities of contaminated dust containing nanoparticles of U and Pu and other radioactive contamination.	
12	BS will have inhaled and inadvertently ingested this dust containing Uraniums and Plutonium	P+
13	U-234 represents the largest fraction of the Uranium by activity and is present in Enriched Uranium due to its low mass and natural activity ratio with U-238	C
14	Research shows that Uranium binds to DNA and has anomalous excess radiogenetic characteristics. It causes genetic damage at very low doses as conventionally assessed by the ICRP model. MoD had been warned about the danger from U-234 in bomb residues by the US in 1953 but it was not measured nor assessed. The Uraniums are alpha emitters and do not register dose on film badges nor monitoring equipment	C
15	Genetic damage from Uranium or other radionuclides is shown by chromosome defects. These were found in the New Zealand test veterans and also in Namibian Uranium miners and Gulf War veterans with measured Uranium.	C
16	Genetic damage is shown by congenital defects in offspring. This was found in three studies of UK test veterans.	C
17	The bombs at Christmas Island also created fallout and rainout of other radionuclides, which were not apparently monitored. The most important of these is Tritium, a form of radioactive hydrogen which is present as radioactive tritiated water HTO with a half-life of 12 y. It is not detectable with monitoring equipment and no measurements of it have been made available.	C
18	The drinking water supply at Christmas Island depended on rainwater and will have been contaminated with Tritium	C
19	BS swam in the sea, the lagoons containing Tritiated water and caught and	C

	ate fish which will have been contaminated with Uranium and other fallout and rainout nuclides	
20	BS died from pancreatic cancer	C
21	Pancreatic cancer is accepted as a radiogenic disease	C
22	Two other vets in the FtT also died from pancreatic cancer. The probability of this occurring in these three is less than 1 in 100,000. This shows that they all three shared a common genetic damage exposure which can only have been the test site radioactivity.	C
23	On the question of dose necessary to cause pancreatic and other cancers, there is a dispute among experts	C
24	For internal exposures the use of absorbed dose as a measure of risk is unsafe and so conclusions about causation cannot be based on absorbed dose.	P+
	The error factor in the current assessment of risk from internal Uranium is greater than 1000.	P
25	The error factor in the current assessment of risk from internal other mixed fission fallout nuclides is greater than 300.	P
26	There is sufficient evidence to raise doubt about the assertion that BS's pancreatic cancer was not caused by his exposures	C

5

SUMMARY AND CONCLUSIONS

5.1 The reason given by the SSD to refuse pensions in the ionizing radiation appeals is based on a faulty radiation risk model and on disinformation by the MoD on the nature and extent of the contamination at the test sites, and the failure of previous cases has been partly a

consequence of SSD presenting false information to the Tribunals and courts (e.g., the background radiation levels at Christmas Island). The evidence from scientific studies in the peer review literature is sufficient to show that the ICRP/BEIR radiation risk model is not valid for internal radiation, and particularly so for exposure to Uranium particulates. This is now an open secret in the scientific community and we and our experts have drawn attention to a range of evidence supporting this, and in addition show that the retired Secretary of the ICRP agrees. This is not a small point, and the Tribunal can be seen as in a Galileo situation in taking the evidence on board.

5.2 The apparent cover-up of the contamination of the test sites by Uranium, and the hysterical response of the SSD lawyers to the AWRE Vixen B report containing key Uranium data which was brought by Gp Capt Ades to the UT hearing in December 2014 points to the lengths that the MoD have gone to suppress the information on Uranium contamination. The same seems to be the case in the US where the standard printout for assessing fallout activities by Harry Hicks of the Lawrence Livermore laboratories actually states that Uranium concentrations in the fallout are ZERO. Uranium was measured in the black rain residues of the air-burst Hiroshima bomb in soils some 40 years after the detonation.

5.3 The apparent failure of MoD to measure or report levels of Uranium at the test sites is particularly difficult to understand given the clear message that was given to them in 1953 by the US expert Karl Morgan who termed it the main residual hazard.

5.4 We present sufficient evidence by reference to peer-review papers and through our expert witnesses to show that the cancers of Mr Battersby and Mr Smith were most probably caused by their exposures at the test sites, or rather, at minimum that the argument that this is the case is based in scientific evidence and reasoning and cannot be dismissed as fanciful.

5.5 Our experts show with reference to scientific reports that Uranium has genotoxic effects out of all proportion to its radioactivity, partly because of its chemical binding to DNA, the main target for radiation effects, and partly for reasons involving its high atomic number and ability to enhance natural background radiation. In fact, as mentioned by our expert witnesses, and of considerable interest, a report has recently been published reporting a large new research initiative funded by the EU to re-examine the health effects of internal exposures to Uranium, thus supporting our arguments about ‘reasonable doubt’. The

European Union has provided a large sum of money for re-opening the issue of Uranium and health through a project CURE, Concerted Uranium Research Europe.

5.6 In addition to Uranium, other unmeasured radionuclides, Tritium and Carbon-14 will have contaminated those on Christmas Island through drinking water.

5.7 We present arguments based on the genetic damage caused by Uranium and which results in chromosome damage and congenital conditions in the offspring of those exposed, either Uranium miners, Gulf War veterans, Iraqi Gulf War populations or New Zealand test veterans. Mr Battersby suffered from this source.

5.8 The considerable evidence from peer-reviewed published studies for congenital effects in the offspring of the veterans is an objective indicator that they shared exposures to a genotoxic substance. This Tribunal has obtained the raw data from the University of Dundee for the largest of these studies and a new analysis of these data show a highly significant 10-fold excess risk of major congenital malformations in all offspring of veterans compared with the standard. This is reported by Prof Howard, an expert on this issue in a submission to the Tribunal.

5.9 Further, the probabilistic argument that four of the appellants suffered pancreatic cancer is in itself, we submit, a reason to suppose that their illnesses were from a common cause.

5.10 Mr Justice Charles's decisions on the standard of proof (Appendix 2) are fundamental to the important work of this fresh hearing in the FtT. We are, moreover, also seized of Judge Stubbs' words in the original FtT, which remind us all that much hinges on this Tribunal, well beyond the actual cases before it today and even so when no precedent can be set.

5.11 A review of transcripts of evidence given by those called by the SSD in the original FtT shows repeated references to 'proof' and/or 'probability' (for example, *'So you would have to go back to our old friend and do some alpha spectrometry to prove it was from uranium not radium. But on the basis of probability, I suspect it's alpha emission from*

radium luminised dials’ [36] S5.2 Mr Heppinstall examining Professor Regan, Day 2, page 61, lines 20-24). Interestingly, here we see an expert witness ‘suspecting’ ‘probability’ which is an unusual juxtaposition; and ‘causation’ contrasted with ‘association’ (e.g., ‘*Well, I think that some of these reports record a finding or an observation of increased numbers, but they may not in my judgment -- and it's certainly not mine alone. They may not have been quite so successful at proving causation. They may have shown association*’ ([58] S5.7 FTT transcript Day 7, page 18, lines 8-12, Mr Metzger cross-examining Dr Braidwood, emphasis added by underlining).

5.12 We submit that the totality of evidence we present goes much further than the term ‘possibility’. It is a many-armed, overwhelming and unequivocal force for change, a change which has been long overdue in this issue of justice for the veterans who have lost or had blighted their lives, and those of their children and grandchildren, because of the need by the military for the development of nuclear weapons, and the associated cover-ups which were necessary, but are no longer necessary, for their testing and development.

5.14 The ICRP/BEIR radiation risk models, as the eminent scientists that signed the ECRR Lesvos Declaration demanded, must be set aside as being out-dated and overtaken by new science, and this is a key issue beneath all cases involving exposures to ionizing radiation both in the atomic test veterans and in those exposed to Uranium weapons residues.

Christopher Busby
Andrew Ades

On behalf of the Appellants

May 15th 2016

REFERENCES AND NOTES

We rely on documents from the previous FtT and UT bundles and by reference to transcripts from the previous FtT and UT hearings. These references are not always written in full but it is assumed that they are sufficient to locate the document in question. As pointed out, we have not been given the previous FtT bundle, and we have located 144 missing documents from the indexes sent to us recently. Documents not already in the previous bundles will be supplied in digital format by us, those referred to in this revised amended Statement of Claim and those cited by our Experts.

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- [4] Prof Shoji Sawada’s report and attachments. S2.6
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- [9] Prof Malcolm Hooper, expert report and responses to questions. S2.7
- [10] DoReMi. CURE: Concerted Uranium Research Report D5-17. Report on an integrated (biology-dosimetry-epidemiology) research project on occupational Uranium exposure. 2/3/15.

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- [17] Smith Appeal Refusal A13, A14 updates
- [18] AB and Others vs. Ministry of Defence; SSD statement of defence case.
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Appendix 1

Decision of Radiation Pensions Appeal: Jean Mahoney vs. Australian Repatriation Commission. Expert Witness Christopher Busby (May 2015)

Note: This was appended to the original statement of claim and submitted to the Tribunal but was not attached by the SSD to the document in the bundle.



DECISION AND REASONS FOR DECISION

[2015] AATA 379

Division **Veterans' Appeals Division**

File Number **2013/2518**

Re **Jean Mahoney**

APPLICANT

And **Repatriation Commission**

RESPONDENT

DECISION

Tribunal **Senior Member Bernard J McCabe
Dr M Denovan, Member**

Date **29 May 2015**

Place **Brisbane**

The decision under review is set aside. The Tribunal decides in substitution that the late veteran's death was connected to the circumstances of his service.



.....[Sgd].....

Senior Member Bernard J McCabe
Dr M Denovan, Member

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CATCHWORDS

VETERANS' AFFAIRS – application for widow's pension – claim that veteran's death was war-caused – contention that veteran's bowel cancer result of exposure to radiation while serving in Japan – exposure of tissue within veteran's colon to radiation – Tribunal not satisfied beyond reasonable doubt that death was not war-caused – decision under review set aside and substituted – decision that veteran's death was war-caused.

LEGISLATION

Veterans' Entitlements Act 1986 (Cth) ss 9; 13; 120

REASONS FOR DECISION

Senior Member Bernard J McCabe
Dr M Denovan, Member

29 May 2015

1. The applicant's late husband, George Mahoney ("the veteran"), rendered operational service in Japan from 5 March 1946 until 23 April 1955 as a member of the British Commonwealth Occupation Forces ("BCOF"). The veteran died on 7 July 1990. The applicant says the veteran's death was *war-caused* within the meaning of s 9 of the *Veterans' Entitlements Act 1986* (Cth) ("the Act") because the cancer that ultimately killed him was the product of radiation exposure he experienced while serving near Hiroshima.
2. We are satisfied the late veteran's death was *war-caused*. We explain our reasons below.

THE LEGISLATION

3. Section 13 in Part II of the Act states that, where the death of a veteran was *war-caused*, the Commonwealth is liable to pay pension by way of compensation to the dependants of the veteran: s 13(1)(a) and (c). Section 8 of the Act identifies when a death can be said to be *war-caused*.

4. Section 120 of the Act addresses the standard of proof and the process by which the decision-maker must make its assessment. In these proceedings, after satisfying itself as to the *kind of death* experienced by the veteran, the Tribunal must be satisfied there is material pointing to the hypothesis offered by the applicant. The Tribunal must then identify the relevant statement of principles (“the SoP”) and consider whether the claim is able to fit within the template of the SoP. (We use the ungainly expression “fit within the template” because we are merely asking whether the applicant’s story as it was told is capable of satisfying the requirements in the SoP. We do not evaluate the story or make findings of fact at that stage of the inquiry.) If we are satisfied the claim is capable of satisfying the requirements in the SoP, we then consider what findings of fact should be made.

The kind of death

5. The death certificate records the causes of death as (a) pneumonia, (b) metastatic bowel cancer (colon) and (c) renal failure. The parties agree that the kind of death for present purposes was *metastatic bowel cancer*, or *malignant neoplasm of the colorectum*. We are satisfied that is an appropriate finding in light of the uncontradicted medical evidence.

The hypothesis

6. The applicant says Mr Mahoney’s cancer was attributable to radiation exposure that occurred while he served in Japan as part of the BCOF. The applicant points to material (summarised in the expert report of Dr Douglas, an occupational physician) suggesting Mr Mahoney would have ingested radioactive dust that resulted in levels of internal radiation doses high enough to trigger the development of metastatic bowel cancer.
7. We accept there is a dispute between the experts over the extent to which Mr Mahoney would have been exposed to radioactive material, and whether his exposure would have resulted in the sort of radiation doses referred to in the Statement of Principles concerning malignant neoplasm of the colorectum (No 37 of 2013, which is the relevant SoP for our purposes).

Does the evidence *on its face* satisfy the requirements of the Statement of Principles?

8. Clause 6 of the relevant SoP sets out a number of factors which might raise a *reasonable hypothesis* connecting *death from malignant neoplasm of the colorectum* with the circumstances of a veteran's relevant service. Only one of the factors set out in clause 6 of the SoP need apply. In this case, the applicant relies upon factor (i):

[H]aving received a cumulative equivalent dose of at least 0.1 sievert of ionising radiation to the colorectum at least five years before the clinical onset of malignant neoplasm of the colorectum[.]

9. *Cumulative equivalent dose* is defined in clause 9 of the SoP to mean:

[T]he total dose of ionising radiation received by the particular organ or tissue. The formula used to calculate the cumulative equivalent dose allows doses from multiple types of ionising radiation to be combined, by accounting for their differing biological effect. The unit of equivalent dose is the sievert. For the purposes of this Statement of Principles, the calculation of cumulative equivalent dose excludes doses received from normal background radiation, but includes therapeutic radiation, diagnostic radiation, cosmic radiation at high altitude, radiation from occupation related sources and radiation from nuclear explosions or accidents[.]

10. The veteran served in the city of Kure, which is located about 20 kilometres to the south-east of Hiroshima. Hiroshima was devastated by an atomic bomb dropped on 6 August 1945. Mr Mahoney arrived in Kure in 1946, about seven months after the blast flattened the neighbouring city.
11. There is no direct evidence of how often Mr Mahoney visited Hiroshima. But there is certainly evidence he did visit: the applicant provided photographs she said were taken by the veteran in and around Hiroshima itself. The photographs show the terrible destruction wrought by the bombing. She also provided photographs of Mr Mahoney engaging in sporting activities. He was a keen sportsman, it seems, and was likely to have participated in sporting events staged in Hiroshima. Dr Palazzo, an historian

engaged by the applicant, reported that sporting venues in Hiroshima were covered in a brown, talc-like dust. Dr Palazzo added it was likely that veterans like Mr Mahoney would have visited Hiroshima regularly for work and leisure purposes. As he explained at p 14 of his report (exhibit 6):

[Mr Mahoney] served for many years in Japan as a part of BCOF in close proximity to the atomic wasteland that was Hiroshima. Like other Australian soldiers it is likely that he visited that ruined city in both an official and a tourist capacity.

12. Dr Busby, who holds a doctorate in chemical physics, claimed live uranium oxide nanoparticles, together with fission products, would have contaminated the ground, air, water supplies and edible produce in Hiroshima and surrounding areas up to 20 kilometres away (exhibit 3 at p 4). In his evidence at the hearing, he said it was “inconceivable” that the veteran would not have inhaled uranium particles in the dust he would have encountered in Hiroshima. According to Dr Busby, those particles would have lodged in the colonic epithelium where high doses of radiation could be delivered to local tissue.
13. The applicant also relied on the evidence of Dr Douglas, an occupational physician with expertise in occupational and environmental toxicology, risk assessment and related research. Dr Douglas agreed with Dr Busby that Mr Mahoney would have ingested dust containing radioactive particles. He said the alpha particles, which were large and especially dangerous, would have continued to emit radiation within the colon for many years. He said the particles would deliver especially high doses to the surrounding tissue. He agreed with Dr Busby’s estimate of the amount of exposure Mr Mahoney would have received in those circumstances. Importantly, he concluded in his report (exhibit 2 at p 9):

Clearly inhalation of radioactive particles of uranium and/or plutonium will result in very high local doses of radiation received by particular cells. Such doses are well in excess of the 0.1Sv required to be a causative factor in the development of cancer of the colorectum as set out in the Statement of Principles

14. The respondent's expert, Dr O'Brien, works for the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA). Dr O'Brien disputes the applicant's case in two respects in particular. He:
- ☐ Says there was not as much radioactive material in the environment as the applicant contends. Dr O'Brien says typhoons recorded after the blast would have washed away a lot of the material (see exhibit 4 at p 7). He also pointed to studies showing the limited area in which fallout occurred. In his oral evidence, he referred to an ARPANSA study in 2002 which suggested only workers engaged in rubble clearance within a comparatively small zone were at risk of significant doses of radiation (exhibit 5).
 - ☐ Disagreed with the methodology used by Dr Busby to measure the cumulative equivalent dose of ionising radiation. Dr O'Brien relied on models developed by ARPANSA to measure dose; Dr Busby said those models were not appropriate in cases of internal rather than external exposure. Dr Busby pointed out the important issue was the exposure of tissue. Dr O'Brien disagreed and explained in his oral evidence that Mr Mahoney would have suffered significant and presumably noticeable harm within a matter of days or weeks if he had received the dosage to the colon contended for by Dr Busby.
15. The argument about the methodology is an important one. Mr Harding, who appeared for the applicant, argued in his submissions that the ARPANSA methodology averaged the exposure across the entire organ (in this case, the colon) rather than making an assessment of the dose to individual cells in close proximity to radioactive material that became lodged within the body. Mr Harding said the SoP does not require that the *whole* organ be exposed to the specified amount of radiation: it would be enough if tissue *within* the colon were exposed to a cumulative equivalent dose of at least 0.1 sievert. In making that argument, Mr Harding relied on the oral evidence of Dr Busby, who pointed out it was the exposure of individual cells to radiation that was important because the whole organ did not develop cancer. Dr Busby explained (transcript at p 70):

the whole organ (including parts that were not exposed, and which might not be vulnerable to the effects of ionising radiation) and the average figure exceeds the requisite level. The applicant's interpretation of the words in factor 6(i) makes sense

[I]t's the dose to the tissue, specific area of the colon, which is important. And of course the dose to that from a uranium particle that's been trapped in the colonic epithelium, because it's only the epithelium that we should be concerned about, this is the surface of the inside of the colon, those are the cells that replicate and those are the ones that develop cancer. The cancer never develops on other parts of the colon, from the muscular part of the colon or from the outer part of the colon. You very rarely get cancers there, almost never. It's always from the epithelium.

16. Dr Busby subsequently pointed out in cross-examination (transcript at p 71) that the ARPANSA methodology adopted the definition of "dose to the organ", whereas Dr Busby said "the Australian legislation" (by which he presumably meant the SoP) refers to "'dose to organ' or 'dose to tissue'" – and it is dose to the tissue that matters (transcript at p 74).
17. Dr O'Brien said in cross-examination there are difficulties associated with trying to assess the exposure of individual cells, but he added there were adjustments made in the averaging process he undertook that took into account the epidemiological data (transcript at p 66).
18. The words of the SoP are crucial. We have already quoted the text of factor 6(i), which refers to receiving "a cumulative equivalent dose...to the colorectum". On its face, factor 6(i) is referring to the organ as a whole, rather than colorectum tissue or even the epithelium. But Mr Harding points out the definition of "cumulative equivalent dose" in clause 9 is taken to mean "the total dose of ionising radiation received by the particular organ or tissue." (Emphasis added.)
19. The applicant is right. The wording of factor 6(i) does not require that the whole of the colorectum be exposed to the requisite level of radiation. Nor does it suggest on its face that exposure of parts of the organ – especially those parts of the organ that are vulnerable

the whole organ (including parts that were not exposed, and which might not be vulnerable to the effects of ionising radiation) and the average figure exceeds the requisite level. The applicant's interpretation of the words in factor 6(i) makes sense to ionising radiation – is only problematic if the exposure is averaged across when one has regard to the reference in clause 9 to “the particular organ or tissue”. It also makes sense having regard to the purpose of the SoP, which is to provide an authoritative guide as to when a condition (in this case, a particular form of cancer) is related to the circumstances of the person's service. As Dr Busby pointed out in his evidence, the risk of cancer only arises when certain cells within the colorectum are exposed to ionising radiation. It would be odd if the Repatriation Medical Authority intended that radiation be assessed across the whole organ (including parts of the organ that were known not to be vulnerable to the development of cancer as a consequence of radiation exposure) when vulnerable but localised areas of tissue might have been exposed to an excessive dose.

20. At this stage of the analysis, we do not need to resolve the factual dispute between the parties as to the amount of radiation present in the environment, or the likelihood of Mr Mahoney ingesting radioactive particles which then lodged in his gut. While acknowledging there is disagreement, we accept there is evidence suggesting Mr Mahoney would have ingested dust containing radioactive material, and that the material would have lodged in his colon and delivered doses of radiation, in at least the amount referred to in the SoP, to the tissues that subsequently became cancerous. It follows we accept the applicant's case fits the template provided by the SoP.

Findings of fact

21. Having satisfied ourselves that the applicant's case fits the SoP, we must now make findings of fact. Most of the facts are not in dispute: the two questions that remain unresolved have been identified above. We will deal with each in turn before considering whether we are satisfied beyond reasonable doubt that the veteran's death was not war-caused.

But he also questioned how much evidence there was of uranium contamination throughout the city in any event. He referred in oral evidence to measures taken by Japanese authorities in the days following the attack at a house not far from the of the blast experienced “black rain” shortly after the bomb was detonated.¹ “Black rain” is a phenomenon that occurs following an atomic blast when large amounts of material are taken up into the atmosphere. That material falls to earth in the course of a downpour which inevitably follows the blast. Dr Busby said the black rain contained radioactive material, including nanoparticles of enriched uranium. (The Hiroshima bomb used uranium-235. Crudely speaking, the bomb worked by firing one mass of uranium-235 into another mass of the same material, which triggered the chain reaction that generated the blast. But only a small proportion of the fissionable material was consumed in the chain reaction. Dr Douglas estimated around 63 kilograms of enriched uranium might have remained, albeit that it would have been vaporised into nanoparticles: transcript at p 16.)

23. Dr O’Brien provided a report dated June 2014 in relation to Mr Mahoney that drew on a report prepared by ARPANSA for the Department of Veterans’ Affairs in July 2002. The 2002 report, titled “Estimations of Atomic Radiation Exposure in Australian Service Personnel in South West Japan 1946-52”, is exhibit five. Dr O’Brien’s report and his oral evidence drew heavily on that report and the studies and evidence it discussed. In his oral evidence, he said comparatively little uranium (the fissionable material within the Hiroshima bomb) would have been deposited on the surface as a consequence of fallout following the blast. While the bomb contained around 60 kilograms of uranium that might not have been consumed in the explosion, only a small portion of it would have returned to earth as fallout in the short term. The rest of it would have remained suspended in the atmosphere or the stratosphere before being slowly and widely dispersed. He referred to records and studies that showed the wind was blowing from the east when the atomic bomb was dropped on Hiroshima – that is, away from Kure, which is located to the south-east of the city, where Mr Mahoney was subsequently based.

¹ Takada, Hoshi, Sawada and Sakanoue, ‘Uranium Isotopes in Hiroshima “Black Rain” soil’ (1983) 24 *Journal of Radiation Research* 229-236

But he also questioned how much evidence there was of uranium contamination throughout the city in any event. He referred in oral evidence to measures taken by Japanese authorities in the days following the attack at a house not far from the hypocentre of the blast, which did not record the presence of enriched uranium: transcript at p 67.

24. Dr O'Brien agreed in cross-examination that fissionable material may have been contained in the black rain but doubted it was especially concentrated. He added that typhoons recorded in August 1945 and March 1946 would have washed away much of the radioactive material in any event. He emphasised radiation assessments conducted by American specialists before the occupation commenced recorded relatively low levels of radiation – low enough for the occupation forces to be satisfied it was safe to enter the affected areas. He added that even if all of the uranium in the bomb fell to earth and made its way into the water supply, his calculations suggested the doses were negligible.
25. Dr O'Brien's evidence is consistent with most of the available research, much of which is referred to in the ARPANSA report in 2002. We acknowledge Dr O'Brien was not familiar with the 1983 study of the effects of black rain but he said it did not change his central conclusion. While the applicant has certainly raised searching questions over the means by which radioactive material might have been dispersed following the blast, there is limited evidence of the presence of dangerous levels of radioactive material in the environment when Mr Mahoney served in the area.
26. Even so, we cannot be satisfied beyond reasonable doubt that Mr Mahoney would not have been exposed to fissionable material, including enriched uranium, during the course of his service.

If radioactive material was present in the environment as a consequence of the atomic blast, would Mr Mahoney have been exposed to a cumulative equivalent dose of at least 0.1 sievert of ionising radiation?

27. The applicant relied on the evidence of both Dr Busby and Dr Douglas in relation to this issue. They argued the real problem in this case was internal radiation, not radiation to the body as a whole. Dr Douglas explained the radioactive material could be contained in

dust. Mr Mahoney could be expected to have breathed it in, and a quantity of the radioactive material would have lodged in his gut where it could have delivered the required level of radiation dose to the portion of the colon that subsequently became cancerous. Dr Douglas was particularly concerned about the presence of uranium isotopes because uranium emits larger (and therefore more dangerous) alpha particles, whereas some other radioactive material, such as strontium, emits smaller beta particles that may not have delivered as high a dose of radiation, even though strontium decays faster (transcript at p 19). Dr Douglas explained in his oral evidence that even a small amount of enriched uranium could deliver a high, focused and localised dose to a small area of tissue within the larger organ. We note Dr Douglas concluded in his report (exhibit 2 at p 9):

In my opinion, there is no doubt that George Mahoney would have received internal radiation far in excess of the cumulative equivalent dose of 0.1 Sievert necessary to meet the requirement for causation expressed in the [relevant SoP].

28. That hypothesis becomes harder to sustain if there was little enriched uranium in the environment, as Dr O'Brien's studies suggest. Dr O'Brien also said that even if there was radioactive material in the dust, the re-suspension factor for dust was so low that it was unlikely a person would ingest significant amounts of material. He said the ingestion of very small particles of uranium that were present in the environment would not deliver the sort of dose referred to in the SoP – although we infer that observation was based on the assumption that exposure had to be averaged over the whole of the colorectum. Dr O'Brien pointed out that while uranium isotopes emitted alpha particles, uranium decayed at a much slower rate than other materials, and was therefore considered less radioactive.
29. Dr O'Brien noted the ARPANSA report of July 2002 concluded servicemen like Mr Mahoney were unlikely to have been exposed to high doses of radiation in the period in question. That report explored the potential for exposure in a variety of scenarios, including internal exposure. He pointed out in his oral evidence that the 2002 report adopted a methodology for assessing dosage and its effect that was consistent with the recommendations of the International Commission on Radiological Protection, an

Dr O'Brien used the methodology and dose estimates in the 2002 report as the starting point in his 2014 report. In the 2014 report, which examined Mr Mahoney's case in particular, Dr O'Brien concluded (exhibit 4 at p 9):

The cumulative committed equivalent dose to the colon was estimated to be considerably less than 100mSv, well below the cumulative equivalent dose to the colon set out in the Statement of Principles for Malignant neoplasm of the Colorectum.

Therefore it is highly unlikely that exposure to ionizing radiation caused by the atomic bomb dropped on Hiroshima would have caused the cancer that led to Mr Mahoney's death.

30. The conclusions in the ARPANSA report would have particular force in this case if we accepted exposure to ionising radiation should be averaged across the entire organ (in this case, the colon), rather than making an assessment of the dose to individual cells in close proximity to radioactive material that became lodged within the body. But we have already explained the SoP calls for us to consider the exposure of *tissue* within the colorectum. If we adopt that approach, it is clear we cannot be satisfied beyond reasonable doubt that tissue in Mr Mahoney's colorectum was not exposed to radiation in the requisite level from minute particles that were ingested into his system. While we accept the preponderance of the evidence suggests it is unlikely that Mr Mahoney would have been exposed in this way, the standard of proof that we are required to adopt means we cannot reasonably exclude the possibility for which the applicant contends.

CONCLUSION

31. The decision under review is set aside. We decide in substitution that the late veteran's death was connected to the circumstances of his service. We did not receive submissions from either party as to the date of effect. If the date of effect is disputed between the parties, each has leave to file written submissions within 7 days of the date of these reasons so that the question can be resolved.

I certify that the preceding 31 (thirty - one) paragraphs are a true copy of the reasons for the decision herein of Senior Member Bernard J McCabe and Dr M Denovan, Member.

.....[Sgd]..... Associate

Dated 29 May 2015

Date of hearing	3 October 2014
Date final submissions received	30 January 2015
Counsel for the Applicant	Mr A Harding
Solicitors for the Applicant	Terence O'Connor Solicitor
Advocate for the Respondent	Mr B Williams

Appendix 2

AN OUTLINE OF THE LAW RELATING TO THE STANDARD OF PROOF, AS DETERMINED BY MR JUSTICE CHARLES' DECISION

A2.1 The present Appellants take this opportunity to set out briefly and solely for the convenience of presentation of their case, their understanding as to the detail of meaning and exposition, as that in turn applies to the implementation of Charles J's finding on the correct & lawful construction of article 41(5) of the Naval Military and Air Forces etc (Disablement and Death) Service Pensions Order 2006 (the SPO). Charles J., himself, summarises that finding at para (5) of his Decision, as follows:

“(5) In short I conclude that:

i) this test places an onus on the claimant¹ to establish by evidence that is not fanciful or worthless (and so reliable) possibilities that he asserts found the existence of that doubt,

ii) the decision maker must carry forward:

- (a) such possibilities, and
- (b) matters about which he has no reasonable doubt,

and so the ingredients of the claimant's case into the judgmental or weighing exercise of deciding whether the Article 41(5) test is satisfied,

iii) that judgmental exercise involves an evaluation of the respective cases of the parties by reference to all of the competing evidence and argument and thus on that basis:

¹ technically by the time the matter reaches the FtT a War Pensions Claimant has already had their Claim rejected by the SPVA, and so already has become an Appellant as against that determination – However, in the context, it is clear that Charles J is here using the term "claimant" so as to include also one who is technically now an "Appellant" before the FtT instead.

(a) the relative strengths and weakness of those cases,
(b) their ingredients and so the possibilities they advance, and
the matters they rely on (including those about which they
assert the decision maker can have no reasonable doubt),

iv) that judgmental exercise may come into play at the first stage
of the process as an evaluation of the evidence and arguments
advanced by the Respondent may at that stage be taken into
account in determining what is or is not a possibility to be carried
forward or what matters the decision maker has no reasonable
doubt about, and

v) this is not a rigid approach but importantly it is based on the
identification and evaluation of possibilities and effective
certainties and it is not based on findings of fact made on the
balance of probabilities that are thereafter treated as established
facts (or effective certainties) or an approach based on which
expert evidence is preferred.

(6) I conclude that the FTT erred in law by not applying that approach
because they did not so identify possibilities but applied an approach to
the ingredients of the claimants' cases that was based on findings made
applying the normal civil standard of proof (balance of probabilities) or
a similar standard for example by preferring the evidence of one expert
to another as opposed to determining whether the evidence they so
rejected raised a possibility that needed to be carried forward in the
decision making process."

(emphasis by way of underlining added)

A2.2 Accordingly, we choose to emphasise in particular the following important
aspects, as we see them:

A2.2.1 Reliable evidence.

The term “reliable”, in relation to evidence that is not ‘fanciful’ or ‘worthless’, is not to be here read as meaning that the evidence must also be sufficiently believed to be true, so as to be in that sense “reliable”, such that the Tribunal itself is persuaded that it can be safely relied upon by it – but rather that, it is “credible” only in the sense of meaning that it is capable of being true or believable, whether or not in the end one chooses, in fact, to so treat it.

A2.2.2 “matters about which he has no reasonable doubt”

Within the context this expression is clearly used to mean only those matters about which the decision-maker has no reasonable doubt that they exist or are true, and accordingly are thereafter to be treated, as if, they are a certainty (accorded a weight of 1)² ; clearly it excludes matters about which he has no reasonable doubt but that they do not exist or are not true – and which, naturally, he ought not to “carry forward” in his decision-making process at all.³

A2.2.3 “the identification and evaluation of possibilities and effective certainties”

Accordingly, mere “possibilities” alone, even though perhaps based on the smallest or narrowest of credible evidence, may not be dismissed or disregarded (as in not taken into account); merely because of any perceived relative lack of gravitas or weight, for example in comparison with seemingly contrary evidence of greater weight.

A2.2.4 “an approach based on which expert evidence is preferred”

² see for example at paragraph 87(v) in the Reserved Decision, for an example where Charles J says that such a finding or certainty can be given a value of 1 (one)

³ see for example at paragraph 87(iv) in the Reserved Decision, for an example where Charles J says that such a finding or certainty can be given a value of 0 (zero)

Accordingly, the present Appellants do not say that their expert evidence is to be “preferred”, over and above or instead of, that of the evidence presented by the SSD instead ; as that would be to fall once again into the very same mistake that the original FtT was found to have made. Instead, we say only that our expert evidence, posits alternate ‘possibilities’ with respect to both of the key factual ingredients, of ‘exposure’ and ‘radio-genicity’, which are not in themselves ‘fanciful’ or ‘worthless’, but which on the contrary are most credible (as above defined) and therefore in that sense ‘reliable’.

A2.3 The overview

Having then adopted this approach, as to the sifting or analysis of evidence adduced, on all sides, the fact-finding tribunal is inevitably still then left with the final legal approach as to its ultimate decision-making role on “reasonable doubt”.

Charles J in his Reserved Decision expressly rejects the notion, as that had been mentioned and indeed relied upon by the original FTT, that the Appellants had simply produced or presented “insufficient evidence” to raise a reasonable doubt.⁴ Equally, he also explicitly rejects the notion that evidence of a “hypothetical nature” or of a case based in part on a “hypothesis” can be left out of account.⁵

Instead he identifies what he terms to be “common grounds” as between the parties⁶ on the correct lawful approach to take to the article 41(5) test and deals with his view as to how he the original FTT Decision strongly suggests to him they improperly or inadequately dealt with each in their turn, as follows:

A2.3.1 The “Reverse Criminal Standard” submission (paras.118-122)

Charles J. Deals with this contention as follows:

⁴ see in particular at paragraph 110 of the Reserved decision.

⁵ see at paragraph 112 – 113 of the Reserved Decision.

⁶ see at paragraph 115 of the Reserved Decision.

“118.. As mentioned earlier, the first of these common grounds of appeal is that the FTT have demonstrated that they misunderstood and misapplied the test or standard “reasonable doubt based on reliable evidence” by their rejection of the submission that:

“only if the FTT is sure that the disease(s) in question did not arise as a result of exposure to ionising radiation during service, that the appellant’s claim will not succeed.”

119. The Secretary of State submitted that the rejection of this submission was correct because it wrongly sought to impose a burden on the Secretary of State and so was not apposite to Article 41 (although it might be to Article 40).

120. Particularly having regard to the common ground before the FTT as to who had the burden, I do not accept that that explanation can be read into that submission, or that it is a natural reading of that submission. Rather, in my view, the natural reading of the submission is one that accords with the common ground before the FTT and me that in Article 41(5) “reasonable doubt” was being used to convey the same degree of doubt as that referred to in the criminal standard of proof. In my view, if the FTT were rejecting that they erred in law.

....

122. *Conclusion on this ground.*

It supports the view that the FTT erred in law.”

(emphasis by way of underlining added)

A2.3.2 Misapplication of *Edwards* as to “insufficient evidence” rubric.
(paras.123-124)

“123. The next ground is that the FTT misapplied *Edwards*. As to that it is unfortunate that the FTT failed:

i) to record the differences between the parties as to how the passage they cite from *Edwards* should be applied and do not set out how they have applied it, and so how they have approached hypotheses,

ii) to provide any explanation of their use of the formula “there is insufficient reliable evidence to raise a reasonable doubt”, by reference to hypotheses or other evidence, and

iii) to provide any explanation or identification of the evidence advanced by the appellants that they thought was reliable or why although it is reliable it is not enough or sufficient to raise possibilities that found a reasonable doubt.

124. *Conclusion on the second ground.* It also supports the view that the FTT erred in law.”

A2.3.3 Mistaken application of a “*led to*” or proof of causation standard (paras.125-126)

“ 125. The third common ground is that FTT erred in law in their approach to Article 41(5) test if what they say in paragraph 493 of the Decision reflects their approach to it namely:

“As is apparent from what we have said in relation to individual claimed appeals a claimant has to show both that he was exposed to ionising radiation and that such exposure led to his claimed condition or (in a widow’s appeal) were causally linked to a cause of death”

This paragraph comes at the end of a long decision and could be a typing error. Nonetheless it is a troubling misstatement of the test and it is surprising that this error was not picked up by the members of the FTT if they were applying the correct approach.

126. *Conclusion on the third common ground.* It too supports the view that the FTT erred in law.”

(emphasis by way of underlining added)

A2.4 Accordingly, it is the current position, with respect to both of the present Appellants , that on the basis of the reliable and credible expert evidence which they will adduce, almost exclusively based on empirical results, as published in peer-reviewed, authoritative and well-respected sources, as relevant and necessary both as to the issues of exposure and radiogenicity, and which we submit satisfies, and indeed vastly exceeds, any reasonably applied more than ‘fanciful’ or ‘worthless’ test ; we will be able to show that there is indeed a “reasonable doubt”, which certainly satisfies the “reverse criminal standard” test, albeit it may arguably not rise to the level of “sufficient evidence” to establish a positive “causal link”, but which we now know it need not do, in order to satisfy the article 41 (5) test.

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