Case Nos.

(1) CAF/3059/2013 ENT 00176/2010
(2) CAF/2055/2013 ENT 00088/2010

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

Table of issues for Closing Statement

Christopher Busby

Cecilia Busby

The following Table is intended to approximate to the suggestions made by the Tribunal regarding layout and presentation of final submission arguments. It will be used as a basis for the oral closing statements.

First we list the issues which are our main areas of argument.

These are the main areas where Tribunal must decide.

Issues of science and philosophy (Dr Cecilia Busby for Gp Capt Ades and Mr Charlton)

1. Standard of proof
    a) reverse criminal standard, not threshold
    b) the process of weighing up of possibilities
2. Issues to do with the nature of science and experts (Dr Cecilia Busby)
    a) scientific paradigms and paradigm shifts
    b) the question of the neutrality of experts in an area of disputed science
    c) evidence for unreliability and bias in the SSD expert witnesses
3. The inter-relationship of scientific standards of proof with that of this tribunal (Dr Cecilia Busby)
    a) balance of probabilities approach for scientific fact
    b) the application of 'reasonable doubt' questions to an area of emerging alternative hypotheses (*R v DSS ex parte Edwards*)

Scientific issues and issues of fact (Dr Christopher Busby)

4. The current ICRP radiation risk model is unsafe for the purposes of predicting or explaining effects of internal exposures received by the veterans.
5. There was contamination of the test sites to the extent that the veterans were exposed to internal radioactivity.
6. Uranium exhibits anomalous genotoxicity which cannot be modelled by the current ICRP model.
7. There was Uranium contamination from the weapons tests at the sites which would have resulted in internal exposures to the veterans.
8. The appellants' cancers are radiogenic.

9. There was genetic damage in veterans caused by their exposure to Uranium and other radionuclides at the test sites which were not measured or assessed e.g. Carbon-14, Tritium, which led to their offspring having a significantly high rate of heritable damage.
10. This genetic damage was also shown by chromosome damage effects, also seen in other individuals exposed to Uranium.
11. The existence of four cases of pancreatic cancer in 13 appellants demonstrates a very high degree of improbability to the extent that this itself indicates that they shared an exposure to some genotoxic agent. This can only have been some agent at the test sites.

The following Table lays out the areas of discussion and refers to locations and evidence which the Tribunal is asked to go to in order to decide on issues of fact and on the outcome of the appeals. It is an attempt to lay out the arguments along the lines suggested by the Tribunal. ***Note (at 27th June, this table is not complete in its references to the transcripts as we are short staffed and had little time).***

Issue	**What we say**	**What they say**	**Our response to their criticisms**	**Evidence we rely on**	**See SoC/ Transcript**
PRIMARY PATHWAYS FOR EXPOSURE					
1. Dry Deposition					
1.1 Disputed meteorology	For Christmas Is reversal of wind direction at altitude	Winds always safely offshore		Loc.cit Nicholson, Grant K, Ash	SB8/135 SB9/141-147 SB1 2.10 (pp10-13)
1.2 Beta and gamma as guide to alpha (measurement time issue)	Geiger counters and film badges don't respond to alpha Uranium and Plutonium	Beta and gamma is always associated with alpha fallout	For fresh fallout only. Beta gamma decay is rapid but the alpha emitters remain and accumulate	Regan	SB11/2-149 to150 SB11/2-2 (199)
1.3 measuring systems	Sticky papers too few			Regan	SB11/2-207 Re

1.4 hot spots	Hot spots inevitable	Hallard models uniform deposition	Hottest levels greater than level assumed by Hallard	Regan, Nicholson	SB11/2 (146) Re SB13/46 ( ) Nicholson Transcript: garden effect
1.5 nanoparticles	Uranium Nanoparticle <1 micron	Particle size not part of dose assessment	Assumption affects dosimetry	Howard, Hooper, Hallard	SB1/2.4 ( ) How SB1/2.7 ( ) Hoo
1.6 assumptions of uniform exposure	Not uniform exposure	Assume uniform exposure	Haylock states that uniform exposure not best method	Haylock, Hallard, Regan	SB11/2 (146) Re Transcript
1.7 Resuspension factor – dust generation	Use 10^{-3}	Use 10^{-4}	Not most conservative assumption	Hallard, NRPB	Transcript SB13/36 Johnston
2. Wet Deposition (leads to surface contamination)					
2.1 Sea water entrainment	Assume entrainment of sea water in GY	not accepted	witness evidence Grap Y exploded too low	Fidderman, Ross, Regan, witness	SB11/2 (242) (Re) SB9/140 SB9/139
2.2. Rainout/washout	Assume rainout/washout from Grapple Y and X	Rainout now accepted		Nicholson, witnesses Ross and Pasquini	SB11/2 SB9/139 SB9/140 SB8/130 SB8/131
2.3 Beta in water	Reduces beta. In water deeper than 2cm no beta	Accepted		Hallard/ Haylock	Transcript
2.4 Sticky filter efficiency	Useless in rain or after rain	Accepted		Regan MacDougall memorandum	SB11/2-253 SB8/133 SB22/13
3. Other Pathways					
3.1 Sea to Land Transfer	Material that fell in the sea returned to	Not modelled	Major missing pathway for	Ash	Transcript SB1/ 2.10 (p13 para

	land as aerial contamination by well known mechanisms		immediate inhalation exposures and surface contamination		31 (Ash))
4. Evidence from later Surveys					
4.1 New Zealand McEwan	Uranium found but natural origin is questionable. Radium found but natural origin is questionable		location of "radium" is on shoreline near Grapple Y explosion point	McEwen, Regan	SB8/128 (p8)NZ FtT transcript SB14/5.22 day 2 pp 59-62 Re
4.2 Washington Surveys	Uranium reported but natural origin questionable	Natural	Rather high for natural in fish samples	Washington survey	Transcript SB6/79 SB6/77
4.3 Repatriation material, identity of apparent radium	Identity of Radium in repatriated material not confirmed by any measurements. Material very strangely widespread for "radium dials"	Radium dials accounts for all the widespread findings of high background.	Could contain U-235 which has same gamma signal. Results of background measurements in repatriation surveys do not agree with New Zealand survey.	Repatriation report, Regan	SB8/125 SB8/136 SB14/5.22 day 2 pp 59-62 Re
PATHWAYS FOR INTERNAL EXPOSURE					
5. Inhalation					
5.1 Resuspension of dust	Major pathway for Uranium and Plutonium nanoparticles	Agree but dispute quantity	Irrelevant if ICRP approach unsafe.	Regan, Ash, Hallard	Transcript, SoC
5.2 Sea to Land Transfer	As above	Not modelled		Ash	SB1 2.10 (p13 para 31 (Ash))
5.3 Inhalation due to	Haircutting major	Haircutting not	Level of exposure in		Transcript SoC

specific activities (barber, cleaning airplanes)	pathway for Smith. Cleaning aircraft without protective clothing major pathway Battersby	included in first report.	dispute		SB10/156 SB16/A-13, A-14 SB16/A2
6. Ingestion					
6.1 Contamination food and water (fish, coconuts, drinking water)	Relevant to C-14 and Tritium	C-14 not included;	C-14 major source of risk.	Hallard	Transcript SB2/2.14 SB2/2.15 SB2/2.16
6.2 Inadvertent ingestion (transfer from hands)	Significant pathway	included		Hallard	Transcript as above
6.3 Swimming	Significant pathway due to sea and lagoon contamination	included	No inclusion of Tritium	Hallard	as above
EXPOSURE TO PARTICULAR ISOTOPES					
7. Constituents of bomb fallout					
7.1 Fission versus thermonuclear (Carter v. Hicks)	Selection of correct spectrum of fallout for type of bomb is necessary	Used fission spectrum fallout from Carter but added other isotopes using subjective judgement.	Thermonuclear and Fission spectrum data available from Hicks (Lawrence Livermore) paper. Hallard not an expert in this area. In cross examine conceded higher dose would have resulted from Hicks.	Hallard, Hicks, Carter	Transcript SB7/96
7.2 Uranium, presence (8 tonnes) and isotopes	Critical exposures are Uranium-238, 235 and especially 234	Not considered important	This exposure is a major source of risk but omitted by Hicks	Hallard, Haylock, Thomas, Howard, Hooper, Morgan	SoC, Transcript SB22/11 (Morgan) SB7/96 (Hicks)

	nanoparticles		also.	minutes.	SB11/2-266 Re SB11/2-159,160 Re
7.3 Carbon 14	1500 moles (1×10^{15}) Bq agreed created in the CI tests.	Entirely missing from analysis	This exposure is major source of internal risk	Hallard, Ash, Regan	SoC transcript SB11/2-141 Re SB1/2.10 Ash
7.4 Tritium	serious hazard in drinking water and other routes	some calculations made	calculations not accepted; dose coefficient not accepted	Hallard	Transcript
SPECIFIC PATHWAYS FOR EACH APPELLANT					
8. Don Battersby					
8.1 Resuspension inhalation from ground and cleaning airplanes			ICRP dosimetry methodology not accepted	Hallard	SoC SB2/2.14 SB2/2.15 SB2/2.16 SB16/A.2
8.2 Inadvertent ingestion			ICRP dosimetry methodology not accepted	Hallard	SoC see above
8.3 External radiation from cleaning airplanes			ICRP dosimetry methodology not accepted	Hallard	SoC see above
8.4 Wound contamination			ICRP dosimetry methodology not accepted	Hallard	
8.5 Contaminated food and water			ICRP dosimetry methodology not accepted	Hallard	SoC see above
9. Barry Smith					
9.1 Resuspension inhalation from			ICRP dosimetry methodology not	Hallard	SoC SB2/2.14

ground, and hair-cutting contaminated individuals			accepted		SB2/2.15 SB2/2.16 SB16/A13 and A14
9.2 Inadvertent ingestion from ground and hair			ICRP dosimetry methodology not accepted	Hallard	SoC see above
9.3 Swimming in contaminated lagoon			ICRP dosimetry methodology not accepted	Hallard	SoC see above
9.5 Contaminated food and water			ICRP dosimetry methodology not accepted	Hallard	SoC see above

DOSIMETRY

- Dosimetry is dependent on risk model
- ICRP unsafe for internal radiation as opposed to external
- ICRP models are not applicable to uranium
- ICRP model is not applicable to micro and nanoparticles
- ICRP is superceded by new biological evidence of non-targeted effects as low dose [Mothersill: FtT Expert Evidence 7, 8, 8a]
- The ICRP model is the key issue. The SSD experts agree that if the ICRP model is wrong for internal dosimetry and/or prediction of health effects the expert reports on causation are worthless.
- Dr Jack Valentin stated at an interview that ICRP model was uncertain for internal exposures and ICRP did not address Chernobyl reported effects issue [see SB6/65]
- There were many unelaborated or admitted uncertainties in Mr Hallard's calculations. These included ICRP coefficients and many other issues to do with subjective choices and omissions of radionuclides and pathways. Together they multiply to make an overall uncertainty of more than three orders of magnitude quite apart from any arguments about ICRP methodology for internal doses. They are separately addressed in section 24.

10. Basis of the ICRP model in Japanese A bomb survivors					
10.1 Removal of NIC control group in 1973	The unexposed control group was removed from the	Not mentioned	Questionable epidemiology	Schmitz Feuerhake, references	Transcript SB1/2.1 ISF SB7/113 (Moriyama)

	study				p6-7 comparison group SB1/2.6 Sa page 5
10.2 All exposure groups defined by distance were equally exposed to internal radiation which has very high hazard effect equivalent to high levels of external exposures (black rain)	Groups classified by external dose by distance from hypocentre; Sawada shows from immediate epilation etc. that equivalent of high level exposures as far as 6km or more from hypocentre, therefore not external.	Not addressed	Cancer yield at 1km and 2km from hypocentre similar though dose is 20 times. Higher levels of cancer in control group. Makes the ABCC/RERF study valueless for internal exposures particularly to Uranium particles	Sawada, Schmitz-Feuerhake, references	Transcript, SoC SB1/2.6 (p12 fig 6) Sa SB1/2.1 (p3 section 4 et seq) ISF SB7/110 (black rain)
10.3 Caesium whole body monitoring in the 70s and 80s.	Caesium whole body monitoring not an indicator of prior A-Bomb exposure at Hiroshima but of global fallout from later testing.	Cs-137 monitoring results at two points in time enabled back calculation to dose at bomb in 1945.	Confounded by huge amounts of global fallout Cs-137 which peaked in 1963.		Transcript
11. Problems applying ICRP to internal contamination					
11.1 CERRIE – dose is not meaningful for internal	Dose not meaningful for internal effects	Dose meaningful concept and averaging for internal effects	High local doses to tissue cells from particles. Cancer begins in cell not in organ. High DNA damage from DNA seeking Uranium, Sr-90 etc.	Bramhall, CERRIE, CERRIE Minority, ECRR, IRSN. Thomas, Baverstock, Valentin.	SoC, transcript SB6/83 Baverstock SB1/2.13 Br SB6/60 (p7para8; p9para18;p13para11) CERRIE SB10/162 (s59-62) Minority report

					SB10/163 (end pages) Lesvos Decl. SB1/2.7 Hoo
11.2 Problem of local dose from a particle accepted by Mahoney case				Mahoney judgement.	SoC appendix SB1/2.1a appendix
12. Epidemiological evidence for problems with ICRP related to Internal Contamination					
12.1 Cancer in Northern Sweden after Chernobyl (Tondel)	Cancer increase in N Sweden after Chernobyl	Not safe to use area contamination (Haylock)	Area contamination correlation used by Hallard	Haylock, Hallard, Tondel	SoC, transcript SB7/121 abstract
12.2 Massive evidence of Chernobyl related cancer and genomic damage in Russian literature.	Several books full of Russian language peer reviewed papers have been ignored by the ICRP based scientific agencies	All these reported effects are due to "radiophobia"	Cancer is not caused by radiophobia and effects have been demonstrated in animals and plants	Bramhall, CERRIE minority report, ECRR2010, Lesvos Declaration	SoC, transcript. SB10/162 ( ) SB10/163 ( ) SB1/2.13 (para12) Bramhall
12.3 Chernobyl thyroid cancers	Very large increase in Thyroid cancer after Chernobyl not predicted by ICRP model	Doses very large, population of children exposed 10 million	Implausible population and doses	Thomas	transcript SB10/163 ( ) ECRR
12.4 Fukushima thyroid cancers (Tsuda)	Very large increase in thyroid cancer after Fukushima not predicted by ICRP	No increase whatever. Reports as wrong and refer to ultrasound survey findings only.	Implausible and shrill defence. Surveys of unexposed in Nagasaki and earlier surveys show no thyroid cancers.	Tsuda, Thomas	Transcript, SoC SB6/75 ( ) Ts
12.5 Heritable	ICRP model for	ICRP model correct	massive evidence	Schmitz-Fuerhake,	transcript, SoC

genetic effects from internal and chronic exposures. (Schmitz-Feuerhake and loc.cit).	congenital malformations after internal or chronic exposure in error by factor of 1000. Relevant to test veteran offspring studies.	for external CM	from Chernobyl increases in many studies in Europe. Also other studies show error.	Haylock, Little, References	SB6/89 ISF SB1/2.1 SB1/2.3 SB22/6 (8 papers on which the ISF genetic papers rely)
12.6 Congenital malformations (Parker, Sellafield)	Increase in congenital malformations at Sellafield	Not addressed; ICRP model assumed sound	Shows error in ICRP	Parker	SB6/89
12.7 Chromosome damage in nuclear workers (Tawn, Hristova)	Increase in chromosome aberrations in nuclear workers	Not addressed; ICRP model assumed sound	Shows error in ICRP	Tawn, Hristova	Transcript SB22/21Ta SB22/22 Hr
12.8 Nuclear Workers (Inworks, Cardis)	highest effects per unit dose in lowest dose group; studies use internal control	not addressed; ICRP model assumed sound	Shows error in ICRP	INWORKS, Cardis	SB5/50 Ca
12.9 Contaminated Sites (Techa River)	ICRP depends on questionable epidemiology for internal exposures	Defense advances Techa river and Radium studies as evidence for adequacy of ICRP	Studies are retrospective and have omitted significant proportion of exposed group		SB4/27
12.10 Mobbs and Muirhead paper	HPA review of low dose effects	Mobbs, Muirhead Harrison paper is about external low dose and ICRP.	internal HPA and not peer reviewed. Omits citation or discussion of critical papers	transcript	SB22/1
12.11 UNSCEAR (reliable and unreliable studies)	ICRP rely on UNSCEAR reports; these omit many critical study citations	UNSCEAR does not cite or discuss reports it subjectively assess as worthless	Scientific secretary of ICRP states in interview that it is wrong for ICRP not	References, ECRR2010, Schmitz-Feuerhake	SB10/163

			to discuss such evidence		
12.12 Childhood cancer near nuclear installations	A plethora of studies shows excess risk from child leukemia near nuclear installations. Needs error factor of 1000-10,000 to explain.	caused by population mixing present at sites where nuclear stations were to be built	no population mixing at Sellafield (COMARE) potential sites near sea and close to pre existing contamination	Transcript, Schmitz-Feuerhake	SB10/163
12.13 Sex ratio effects after exposures.	Sex ratio changes after low dose exposures from Chernobyl, nuclear sites, weapons fallout show genetic damage at low internal doses	not addressed by ICRP	consistent with congenital malformation and chromosome evidence.	Schmitz Feuerhake, references (Scherb)	SB7/118
13. Anomalous Uranium Toxicity					
13.1 Genotoxicity of Uranium	Uranium has anomalous genotoxicity and cannot be modelled safely using ICRP dose	Uranium is weakly radioactive and can be modelled in terms of dose as calculated using ICRP coefficients	Evidence from theoretical (photoelectron), cell culture and epidemiological studies not addressed by ICRP	Howard, Hooper, CURE, Thomas, Miller, other references	SoC, transcript SB1/2.7, 2.8 SB7/100 Mi SB7/101 Mi SB7/97 Hu SB6/89 St
13.2 Particles of Uranium	Nano Particles of Uranium pass the lung, exhibit anomalously high local dose from alpha emission to local cells (warm particles) and	Uranium particles can be modelled by ICRP method and energy diluted into kilograms of tissue	Evidence in the literature supports our position	Howard, Hooper, other references	SoC, transcript SB10/163 ( ) ECRR SB1/2.7 and 2.8 ( ) Hoo SB1/2.4 ( ) How

	photoelectron effects				
13.3 Ionic bonding to DNA	Uranyl ions bind to DNA. These are the soluble form of Uranium in the body	SSD does not allow that "Uranium" binds to DNA but accepts that Uranyl Acetate does.	Absurd argument. Uranyl acetate is the Uranyl ion. Thomas accepts that soluble uranium binds to DNA	Thomas, Hooper, references	SoC, transcript SB7/97 SB6/86
13.4 Secondary photoelectron effect	High atomic number elements absorb natural background gamma radiation as 4^{th} power of Z and re-emit as photoelectrons into tissue. Uranium-238 has highest Z = 92.	Accept this; question its relevance	8 tons of U-238 in the combined Christmas Island bombs	Howard, Hallard, refernces	SoC, transcript SB1/2.4 SB13/44
13.5 Uranium 234	U-234 present as most significant fallout exposure	not considered	referred to by Oak Ridge health physicist Karl Morgan in 1953 meeting	Morgan	transcript, SoC SB22/11 Morgan
13.6 In-vitro evidence of uranium damage to DNA	Anomalous genotoxicity shown by lab experiments on cell cultures	Thomas says not done on stable Uranium	No such thing as stable Uranium	Thomas, references	Transcript SB7/100 Mi SB7/101Mi SB6/86 St
14. Chromosome damage and birth defects in Uranium-exposed populations					
14.1 Gulf War veterans	present	small numbers; but hypothesis generating	shows an effect	Hooper, references	transcript SB7/93 Ar SB7/98 Ka SB6/89 ISF
14.2 Uranium miners	significant	small numbers; but	shows an effect	Hooper, references	transcript

	chromosome damage.	hypothesis generating			SB7/124 Za
14.3 Uranium workers	cancer effects at low doses	hypothesis generating	shows an effect	Hooper, references	transcript SB1/2.7 and 2.8 Hoo SB/85 Canu
14.4 Drinking water, North Carolina	cancer in exposed populations	not peer reviewed so can be ignored	shows an effect	Hooper, references	transcript SB7/122 Carol
EVIDENCE FOR GREATER HARM IN TEST VETERANS THAN PREDICTED BY ICRP MODEL AND ACCEPTED CONTAMINATION					
15. Epidemiological evidence related to cancer					
15.1 Epidemiological evidence of Test vets cancers (NRPB / Parker, Rabbitt Roff)	Retrospective; 15% missing cases	accurate	unsafe	Parker, Rabbitt Roff	Parket FtT reports 2.1.6, 2.1.7, 2.1.10
15.2 Australia (Carter)	Retrospective; missing cases	accurate (greater levels of cancer than UK study)	unsafe	Parker	
15.3 New Zealand (Pearce)	Retrospective; missing cases. 5.6-fold excess leukemias at low doses.	accurate	unsafe	Parker	Parker FtT 2.1.9 SB22/4
16. Epidemiological evidence relating to offspring					
16.1 Rabbitt Roff, all offspring 1998	high levels of congenital effects in offspring	not addressed	congenital illness in offspring is indicator of exposure of father	Rabbitt Roff	SB10/154 SB7/115 SB7/116
16.2 Busby and de Messieres 2006	high levels of congenital effects in offspring	study protocol attacked	levels too high to be all result of selection bias	References	transcript SB6/84
16.3 Howard 2016, based on third party disclosure	high levels of congenital effects in offspring	study protocol attacked	levels too high to be all result of selection bias	Howard	transcript SB1/2.9 How

16.4 Rabbitt Roff, New Zealand ships birth outcomes	very high levels of congenital effect in offspring correlates with chromosome damage	not compared with national population	ridiculous response by Prof Thomas	Thomas	transcript SB10/154 Ro
17. Evidence for chromosomal damage					
17.1 New Zealand test vets (Rowland and Wahab) – NB low level of controls – healthy worker effect	3-fold excess risk of translocations in NZ group	1. range of doses too high 2. period from exposure to measurement too long 3. wrong statistical test	1. doses are deduced and may be much smaller. 2. studies show no damage is seen below 100mSv so there is a cut off 3. studies show that these translocations are long lived 4. Correct statistical tests used 5. Study and correct controls accepted by UK NRPB	Schmitz-Feuerhake, Howard, Haylock, references	SoC, transcript SB7/123Wa SB1/2.1, 2.2,2.3 ISF SB22/24 HPA review SB10/154 Ro
MEDICAL CONDITIONS					
18. Don Battersby					
18.1 Pancreatic Cancer	causal	accepted as radiogenic after FtT but not now	peculiar logical argument		B10/155 update Dec 2012 New award for Pancreatic cancer
18.2 Chronic Lymphocytic Leukaemia	causal	not accepted as radiogenic	accepted by USA NIOSH and found in several studies of internally exposed	Haylock, Thomas, Schmitz-Feuerhake, Howard, references	SoC, transcript SB1/2.1 ISF SB1/2.4 and 2.5 How NIOSH refs (see below)

19. Barry Smith					
19.1 Pancreatic Cancer	causal		positive ERR found in nuclear workers; rare cancer small numbers	Schmitz-Feuerhake, Thomas, Haylock, refernces	SoC, transcript SB5/50 Cardis see below
CAUSATION • The SSD has already awarded a pension to DB for pancreatic cancer; hence they have conceded both dose and radiogenicity. What therefore remains is the radiogenicity of CLL as the only issue • Therefore dose is the only issue with BS, as pancreatic cancer has already been conceded as radiogenetic • However, below we lay out arguments as to both radiogenicity and dose for both					
20. Chronic Lymphocytic Leukaemia					
20.1 Evidence for radiogenicity (papers by Inge, Howard)	radiogenic according to recent publications post 2000.	not radiogenic	accepted by NIOSH 3 out of 5 experts agreed.		SB1/2.1 SSD NIOSH discussion
20.2 A bomb studies	not radiogenic but rare in Japanese	not radiogenic	external exposures not internal (which was the same in all groups).		
20.3 NIOSH	radiogenic	not radiogenic	SSD experts vs. main new body of opinion.	Haylock, Thomas, Schmitz-Feuerhake, references	SB6/58a NIOSH SB6/59 NIOSH SSD NIOSH discussion transcript
21. Pancreatic Cancer					
21.1 Evidence for radiogenicity (Inge, Cardis)	Cardis nuclear workers study gives positive ERR of 2.1/Sv so radiogenic	the 95% CI is (-0.5, 6) so this is not significantly different from zero	The point estimate is well to the positive side of zero. Statistical significant is low because of small numbers and assumption of Linear	Schmitz Feuerhake, Haylock, Thomas	SoC, transcript SB5/50 Table 1

			no Threshold		
21.2 A bomb studies	show no significant excess risk	therefore not radogenic	Small organ, those with cancer die quickly, not included at proper rate	Schmitz-Feuerhake	transcript
22.3 NIOSH	Accepted as specific input to the radioepidemiological program	SSD does not consider US Centre for Disease Control as an authoritative body	NIOSH is an authoritative body	Haylock	transcript
22. Concerns about Probability of Causation Calculation					
22.1 Healthy soldier effect	Haylocks methodology should not employ 1.0 in denominator of Probability of Causation calculation but use healthy soldier coefficient of 0.8.	Uses 1.0		Haylock	transcript
23. Probability calculation					
23.1 Low likelihood of 4/13 appellants with Pancreatic Cancer	probability of 4/13 cancers for a cancer with incidence rate of 2 percent is less than 1 in 1000	Refuses to do calculation. Instead calculates rate in veterans NRPB study.	Evidence that levels of this cancer are unusually high in this appellant population. NRPB 1990s database is of younger veterans and not applicable for a cancer of old age.	Haylock	SoC, transcript SB6/71 rates for pancreatic cancer SB6/82 Rabbitt Roff successful appeals MM same argument
24. Uncertainties in Mr Hallard's doses					
24.1 Many					

cumulative uncertainties in Mr Hallard's dose calculation					
ISSUES RELATING TO SCIENTIFIC CUTURE See discussion					
ISSUE RELATING TO EXPERTS See discussion					

Sequential presentation of argument: Possibilities and certainties. These are copied from the Statement of Case but have not changed as a result of any evidence presented in the hearings.

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 resuspended 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 my 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. DBs first children were born with fatal birth defects. Genetic damage and cancer was found in Iraq in individuals with excess Uranium in hair.	C	
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	Px	
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	C	

	genetic damage exposure which can only have been the test site radioactivity.		
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 DBs 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 Uraniums 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 resuspension.	C
9	The air over the whole of Christmas Island will have contained	C

	nanoparticles of Pu and U, resuspended from material on the ground by well known and described physical mechanisms and available for inhalation and inadvertent ingestion.	
10	Every individual on the island will have had contaminated dust in their hair.	Px
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 and cleaned the room regularly, generating quantities of contaminated dust containing nanoparticles of U and Pu and other radioactive contamination.	Px
12	BS will have inhaled and inadvertently ingested this dust containing Uraniums and Plutonium	Px
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	C

	available.	
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 ate fish which will have been contaminated with Uranium and other fallout and rainout nuclides	C
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.	Px
	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

Christopher Busby
Cecilia Busby

27th June 2016

Appendix

Mr Williams notes for Closing submissions for Battersby & Smith:

Mr Williams asked us to draw attention to the behaviour of the SSD throughout these hearings. He has been the filing clerk and bundles issues person who has dealt with all the documents on behalf of Gp Capt Ades and Dr Busby. We do not make Mr Williams document part of our formal closing submissions but we believe that it might be valuable to future Tribunals to have some flavour of the difficulties suffered by those trying to examine the facts in these areas.

Original Index

1. Grounds for appeals & Statement of Case
2. Guiding principles

Challenges faced by the Appellants

3. Relations between the SSD and the Appellants
4. Historical and current imperatives
5. Guiding principles – level playing field? Military Covenant? Radiation Risk Assessments?
6. Effects of Delayed proceedings and disclosure
7. (Non-response to Appellant propositions?)
8. Denial of the existence or availability of evidence, and of evidence supplied by the appellants
9. Deception on issues fully known to the SSD, their agents or representatives
10. Disclosure, delayed disclosure and non-disclosure

Exposure - Evidence against the Odds

11. Reconstructing the forensic history of UK nuclear tests
12. New evidence from photographs
13. New evidence from Met Charts
14. Contrasts – Australian and Pacific test disclosure
15. Ionising Radiation Exposure risks and pathways
16. Sources: weapon design and deployment issues
17. Environment: Weather conditions
18. Weapons effects & immediate IR hazard potential
19. Explosion types, IR sources, multiple dispersion & deposition pathways
20. Radiation and fallout monitoring – don't look don't find?
21. Cumulative radiation risks – UK and US tests (Clare).

Conclusions for Battersby & Smith Appellants:

a) Maralinga tests - small but dirty, multiple exposure pathways & cumulative R-Risks
b) Pacific tests – no clean bombs - entrainment
c) Pacific tests – minimal stratosphere dispersal, more local
d) Pacific tests – fallout charts withheld
e) Pacific tests – adverse weather, variable winds & blow back,

f) Pacific tests – sea contamination anomalies

g) Pacific tests – the GY Shackleton diversion

h) Summary of exposure hazards per test

i) Pacific tests – need for further investigation and disclosure

1. Grounds for appeals & Statement of Case

1.1 The two appellants that we represent participated in the UK nuclear test programmes in Australia and the Pacific (Christmas Island) between 1956 and 1959.

1.2 They were deployed at different times, in different operational roles, and facing different operational exposure risks. Don Battersby was exposed directly to the four relatively small but very “dirty” atomic tests in the Buffalo test series at Maralinga within a period of 5 weeks (Met Office summary of UK tests).

1.3 Barry Smith was deployed to Christmas Island just over a year after 9 UK nuclear tests were held on or near Christmas Island in 1957-58, and similar levels of radioactive fallout were recorded on the island from at least 20 of the 35 devices fired in the US Hardtack test series in the Marshall Islands (Clare).

1.4 Both died of Pancreatic cancer for which Don Battersby was awarded a 100% war pension on the day he died, backdated several weeks to the date of his Further Condition Claim. Don Battersby had suffered other two previous health episodes, both potentially related to his service at Maralinga – the death of severely deformed twins
born (one stillborn) 3 years after he witnessed the first Buffalo test shot, and CLL diagnosed shortly after he had a stroke. His appeal was for his CLL.

1.5 Don Battersby survived about 11 weeks after submitting his Further Condition Claim which was granted as being “attributable to service” and that his pancreatic cancer was accepted as a “radiogenic” condition (refer SPVA Certificate of Entitlement and Assessment dated 23 April 2014
“I certify that … these disablements are due to injuries which are attributable to service, label Pancreatic Cancer. Reasons for decision: The evidence for the label is at doc 32. The SOS has previously accepted that he served in Maralinga. Reasonable doubt is raised that the condition arose as a result of ionising radiation exposure during his service at Maralinga. Therefore attributable to service. Mr Battersby is being treated palliatively and his prognosis is poor, which is reflected in the assessment.” Dr P. Bayjoo.

2. **Guiding principle**s

2.1` The Appellants' claims are based on the principles of the Servicer Pensions Order passed by Parliament to offer some financial assistance to ex-service personnel who have contracted a serious medical condition attributable to their military service to the Crown.

2.2 Both men were already seriously ill when diagnosed and when they made their original war pension claims. Their original claims were rejected on different grounds in or around 2009 and after an adjournment for Barry Smith, were subsequently referred for inclusion in a collective appeal to be heard by Mr Stubbs. This was further delayed by the withdrawal of Rosenblatt Solicitors from acting for several other appellants, while they did nominally represent Barry Smith.

2.3 We respectfully ask the Tribunal to consider whether the principles of the Military Covenant approved in 2011, mainly for the benefit of serving personnel and their families, should also apply to ex-service personnel and their families?

2.4 We ask whether a period of nearly 7 years from their original war pension claim to date, during which both Appellants have died, is in any way fair to the late appellants, and to their families?

Challenges faced by the Appellants

3. Relations between the SSD and the Appellants

3.1 We are concerned that in their earlier appeals both men suffered inappropriate actions by the SSD. When Barry Smith appeared for his first appeal it was adjourned because of a "missing" document that he had provided three months earlier by recorded delivery –a report by Prof Sawada. He died before the adjourned hearing could be held. Delay is a repeated theme in the conduct of the SSD in the experience of these and other appellants and in previous actions by nuclear test veterans.

3.2 In the previous FTT bundle we noted that Don Battersby's first witness statement, specifically referring to the death of the twins born to his wife three years after his service at Maralinga had been omitted from the bundle index though the document was physically present. This indexing omission was corrected at our request in the UT Appellants' Bundle.

3.3 Dr Busby's reports on behalf of the Appellants, which they had been assured would remain before the Tribunal although Dr Busby would not be called, were not indexed. Like Don Battersby's witness statement this omission would clearly have impeded the Tribunal's access to this evidence consisting eight documents total several hundred pages.

3.4 Major Frank Batchelor's meticulously compiled Witness Statement regarding the UK tests in Australia for the 2008 appeals and specifically approved for inclusion in the 2013 bundle was found to be missing at least 6 exhibits including curiously Exhibit 21 regarding the isotopic composition of weapons used in the Vixen trials. The SSD expressed surprise that these exhibits had been omitted

apparently as a copying error though they been before a major case before. In view of the scope and detail of Major Batchelor's Witness Statement it seems unlikely that the SSD would have been unaware of the entire document. When the missing exhibit was provided to the Upper Tribunal the SSD raised a serious security objection to it. They had opportunities to question the inclusion of an apparently classified document in 2008 and in 2013 but had not done so. The copying "error" deferred a potentially embarrassing issue until the document was re-introduced in 2014 when it provided the opportunity for a dramatic interruption of Group Captain Ades submission to Judge Charles.

3.5 Major Batchelor's Witness Statement was to be included in the Supplementary Bundle with all the previous FTT Witness statements (Bundle F tabs 2 & 6) but the SSD chose to leave that bundle in the FTT Library. The Tribunal may find that the UT copy (FTT15) has a complete list of supporting exhibits from AB1-AB23. Our UT copy stops at AB14. We commend it to the current Tribunal as one of the most concise but comprehensive assessments of the hazards faced by Australian and UK personnel deployed to UK nuclear tests in Australia. It highlights the exceptionally high activity of U234 which is concentrated with U235 in the enrichment process, together with hazards from other extremely hazardous materials including Polonium and Beryllium that have not been discussed in the current hearing. A redacted version of tab AB21 was provided by the SSD in December 2015. It does not appear in the Supplementary bundle.
3.6 The SSD has been playing cat and mouse with Major Batchelor's witness statement over at least three War Pension hearings – perhaps a tribute to the seriousness of his evidence and the importance of making it less accessible than more benign documents.

3.7 The SSD has proved highly adept at mis-indexing, omitting, excluding, redacting, delaying or ridiculing inconvenient evidence from the Appellants' case over the past 5 years.
3.8 We ask the Tribunal to consider that the SSD, his expert witnesses and counsel have had or should have had, access to the complete UK nuclear test archives of technical, environmental and medical data from the earliest war pension appeals. For example the photos disclosed to Group Captain Ades and Mr Williams on 24th February 2016 were declassified in September 2015. They were potentially available to the SSD's expert witnesses months before they were made available to the Appellants. Likewise the Met Office upper winds data for the Grapple test series was summarised for AWRE in 1985. It was disclosed to the Appellants in December 2015. The SSD declined to make a copy of the First Tier Tribunal Bundle available to the appellants until it was included in the Upper Tribunal bundle in 2014. The Appellants were unaware that almost half the Generic documents (143 documents) were not included. These were released to the Battersby and Smith Appellants in April 2016.

3.9 In these circumstances any omission of evidence by the SSD without an explicit security justification (such as the isotopic composition of warhead materials) must be considered deliberate concealment of evidence known to the SSD that might indicate more serious ionising radiation hazards to UK and Commonwealth personnel in the course of UK nuclear tests in Australia and/or the Pacific.

For example non-disclosure of full fallout plume charts for any and all of the Grapple test series, or of measurements of uranium isotopes from alpha spectrometry of airborne dust and soil samples known to have been returned to the UK for laboratory testing.

3.10 Furthermore, given the SSD's in depth access to for example meteorological data, environmental test records, and expert opinion on both, for the SSD to maintain that for example most of the radioactive debris from the Grapple test series went into the stratosphere to be distributed around the globe with minimum local fallout on Christmas Island must be questioned. Meteorological and photographic evidence indicates that most the nuclear clouds were retained below the tropopause. This fact acknowledged by the SSD's Met Office witness Mr Stretch at least for the largest test, Grapple Y, indicates that questioning to suggest the stratosphere dispersal proposition was deliberately misleading. 3.11 The same issue of deliberately misleading information applies to the suggestion that tests were only conducted when winds would carry cloud fallout safely offshore to the west or south west, when Met evidence known since 1985 indicated that upper winds would have carried the main fallout clouds for Grapple X and Y to the East. The most recent case of this recurring theme was incomplete information given to Mr Hallard about the role of Shackleton aircraft in radiation monitoring. The aircraft's prior mission during the test itself was not mentioned, although detailed flight logs of Shackleton Met Recce flights are included in the Met Office archives at Exeter e.g. for WB828 on 8/11/1957 (Grapple X).

4. **Historical and current imperatives**

4.1 Several members of the Battersby and Smith team are ex-service or reserve personnel, and/or children of service personnel. We are aware of the very different and sensitive international and military context of the Cold War that influenced military and scientific decision making during the UK nuclear test series. We appreciate the urgency of developing and testing atomic and nuclear devices for the UK to stay in contention with the USA and USSR in nuclear weapons capability.

4.2 We also appreciate that considerable care was taken by the teams planning each test shot to consider appropriate weather conditions, tactical burst height and potential fallout hazards, as well as potential accidents such as crash on take-off, or malfunctions causing surface instead of air bursts, before planning each test. However weather conditions were seldom ideal and serious errors were made with several of the Australian tests according to reports such as Gordon (SB9.143). The plans for every test were complex and calculated risks, against an imminent test ban treaty.

4.3 At the same time most tests were also opportunities to test the resilience of personnel and equipment to maintain combat effectiveness during and after exposure to atomic and nuclear weapons of all sizes, over land or sea. Some radiation exposures were unavoidable such as for personnel involved in cloud sampling and aircraft decontamination. Others must have been known to be exposing personnel to potentially serious radiation exposures without protection e.g. entering forward areas soon after ground or low air burst tests.

4.4 The issue of combat resilience concerns immediate operational effectiveness during and up to 48 hours after exposure to a nuclear

explosion. Within this time period the paramount concern was and still may be exposure to gamma and other external radiation (e.g. X-Ray, UV, & Infra Red). Longer term health hazards from internal radiation through inhalation or ingestion were not, and still are not an immediate military priority, until the potentially acute toxicity of uranium oxides began to be recognised in the last 15 years.

4.5 These priorities might account for serious deficiencies in health and environmental monitoring during UK nuclear tests in the 1950s. They may partially account for ongoing indifference, or lower priority for, health hazards of internal radiation from low gamma emitting elements like uranium by the SSD.

4.6 But in considering War Pension claims for ex-service personnel suffering severe often fatal illnesses after serving in the UK nuclear tests, the SSD cannot claim either secrecy, or imminent nuclear war, as a justification for ignoring the severe long term occupational health consequences of exposure to chronic internal ionising radiation from long half-life, alpha-emitting elements. In civilian and commercial organisations employers face severe compensation, and potentially negligence claims, for overlooking, or failing to mitigate, known long term occupational health hazards such as internal radiation or other carcinogenic, toxic or mutagenic agents. The SSD cannot plead ignorance of the causes and consequences of radiation risks for military personnel, ex-service personal, and their families.

5. **Guiding principles – level playing field? Military Covenant? Radiation Risk Assessments?**

5.1 In trying to represent the families of our two deceased Appellants we do not have the financial, legal or technical resources of the SSD. In offering assistance since 2010 or earlier we did not anticipate the immense commitment of time and cost that would be required, and without recourse to Legal Aid. However the SSD's intransigence in these cases has hardened our resolve to represent our Appellants to the best of our ability.

5.2 In considering the relative input of our experts with those fielded by the SSD we ask the Tribunal to consider that they have contributed, like us, mainly pro-bono. In the case of Dr Ash we did not have the photographic evidence to show him until the last week of February, together with Met Office data soon after, and then most relevant documents from the previous trial bundle. He had scarcely 3 weeks to digest this information and to write his report, nor facilities to browse previous trial bundles. The SSD questioned his labelling of GZ2 (Flagpole) as GZ3 (Halliard). Both inshore tests were at the same location with similar images and effects on the sea and adjacent island. The Grapple Z album is poorly sorted and labelled but similar conditions and effects applied to GZ2 and 3. The smaller and lower balloon mounted tests over the land, GZ1 and GZ4 caused more serious entrainment and winds towards the populated area.

5.3 The SSD's witnesses had considerably longer to prepare their reports, presumably paid commercial fees. They offered to finance Professor Regan but he did not accept the request to participate.

6. **Effects of Delayed proceedings and disclosure**

6.1 New data from the Met Office archives (SB9.141-147) has confirmed earlier evidence of the reversal of wind directions at cloud height compared to sea level, particularly for Grapple X and Grapple Y, first indicated in the NOAA simulations done in 2010 which were excluded from evidence because they had been submitted via Dr Busby, though not created by him. Some Met Office wind charts also suggest local cyclone effects after some tests which need further analysis and interpretation.

6.2 The Met Office and the SSD have more sophisticated computer programmes than NOAA for simulation fallout from nuclear weapons. It seems reasonable to think that all the Grapple test series would have been re-analysed using these systems. However, unlike the Australian test series where local and country-wide fallout regions were charted (Gordon SB9.153) the SSD chose not to disclose any fallout charts or simulations for the Grapple test series. Since disclosures occurred so late there was not time to ask the Tribunal to instruct further disclosure.

6.3 Similar problems arose due to the time taken for Dundee University to agree to disclose the Rabbitt Roff survey data. There was very little time to do more than a brief analysis of it. This is most unfortunate because it appears to be the largest independent survey of the UK test veteran community (not SSD or industry sponsored).

Exposure - Evidence against the Odds

7. Reconstructing the forensic history of UK nuclear tests

7.1 Like the Appellants, the Tribunal may have to take a forensic approach to try to reconstruct a more comprehensive picture of what really happened at each test, what fallout or other neutron activated contamination occurred, and by what land, sea, air and ecological pathways this may have affected personal on Christmas Island, on naval crews offshore, and aircrews and ground staff.

7.2 Evidence that appears to have been withheld may provide signposts to issues for further enquiry. It is possible that large scale fallout plume surveys were deliberately avoided on a “Don’t look, don’t find” basis. However given the meticulous and diligent charting of Shackleton meteorological reconnaissance flights, and of Ship’s logs, it seems curious that they were not equipped to do some radiation monitoring and fallout sampling as well.

8. New evidence from photographs

8.1 Even the small shots at Maralinga show the intense suction effect below rapidly rising fireballs which created strong after winds drawing freshly neutron activated soil into the stem and possibly through the fireball in some tests. Dr Ash explains this.

8.2 The Maralinga photos (particularly of a later test, Antler) show massive disruption of soil from blast effects (air pressure and seismic) extending some distance from surface zero and making this available for entrainment and surface winds. Similar effects – dark

coloured clouds - can be seen over much of the southern tip of Christmas Island in photos from Grapple X, Y and the Z series.
8.2 The early Grapple tests G1, G2, G3 at Malden Island also show development of a tube like structure below the stem often descending to sea level. However the Grapple X and Grapple Y rounds were an order of magnitude more powerful with large areas of dark cloud rising from land and sea into the stem.
8.3 The SSD has maintained a view also proposed in early editions of Glasstone that air burst weapons provide minimal local fallout. Buffalo 4 was a very low air burst with obvious entrainment. Grapple Z1 and Z4, Pennant and Burgee, were of a similar size to the bombs used at Hiroshima and Nagasaki. Their balloon lifted bursts were relatively low but clearly produced enough updraft for entrainment of soil and dust. Grapple X and Y appear to have been detonated below the target altitude of 8000. In view of the size of their fireballs, vaporisation and dust clouds (within one or two fireball diameters of the sea) their updrafts appear to have produced large scale entrainment, contrary to the "clean" air burst bomb theory. According to Glasstone entrained material is more likely to return as local fallout.
8.4 In both Grapple X and Grapple Y a very wide stem developed and descended down to sea level. At some point entrainment stops and cascades of condensed water or possibly ice from higher altitudes return to the surface, spreading out over a wide area (5-10 miles?) like the base of a wine glass as seen in stills from the AWE 32 IWM video in Stretch's report (SB13.45) and Mr Johnston's diagram in SB13.,40b
8.5 Some of the photographs of Grapple Y appear to show much of the centre of the cloud collapsing over a wide area, not blowing away in the stratosphere. Times are not given for this stage. Dr Ash warns of the various pathways by which this material may have reached the surface of the island and sea, debris, fallout or rainout from the eastern half of the cloud descending into onshore winds and blowing back over the island. While rain might evaporate in warmer, lower air, the solid dust particles would remain. Ships and aircraft offshore, both east and west of the island may have been contaminated with fine particles. Heavier rainfall may have contaminated lagoons on the island, seldom mentioned in sampling reports.

9. New evidence from Met Charts

9.1 The Met Office archives contained a wealth of contemporary records of surface and upper winds before and after all the Christmas Island tests, and covering the central Pacific region. The area charts show main flows of winds at altitudes from sea level to 50 and sometimes 60,000 feet. Wind arrows show direction and strength. Charts for Grapple X were annotated in SB9.141. Tabs 142-147 contain charts for the Grapple Y and Z series sorted in ascending altitude before and after most tests. Altitudes and times are shown on some charts. Relevant sections of the Met Office summary (Grant 1985) are included.
9.2 The Met Office records are a rich public domain source for future analysis of potential local and regional fallout patterns from the Grapple test series. Charts for other time periods e.g. July 1958 would have been used to track the fallout from US Hardtack tests in the

Marshall Islands which produced frequent peaks in the air sampling data on Christmas Island seen in charts in the Claire Report. These were seen but not copied for the Tribunal. With hindsight the extent of US test fallout, many of which were sea level detonations entraining thousands of tons of water, may have been an important addition to cumulative radioactive fallout on Christmas Island.
9.3 A question of non-disclosure arises again after viewing the Met Office Archive charts. Until 2011 the Met Office was part of the MoD. This rich source of meteorological data must have been analysed in great detail for the Grapple test series. It may also have contributed to the meteorological archive data sets for 1957 and 1958 available in the US NOAA HYSPLIT programme which was used to create the reports excluded at the SSD's request. They would also have been used to test the Met Office and MoD nuclear fallout simulation programmes. The Tribunal should not have to (and chose not to) rely on amateur NOAA simulations of Grapple fallout dispersion and deposition when the AWE, MoD, or classified records in the Met Office contain a full analysis and interpretation. With patience Tribunal members can explore some of the original data from the tabs in SB9.

10. **Contrasts – Australian and Pacific test disclosure**

10.1 By coincidence our two Appellants, the late Don Battersby and Barry Smith, represent the two different UK nuclear test arena's in Australia and the Pacific. Comparing available evidence there is far more data about nuclear fallout for the Australian tests than for the Grapple test series. This contrast may be due to the far greater investigations pursued by Australian veterans and the Australian Government in their Royal Commission enquiry, and the documents disclosed to it, key sources of information for Major Batchelor's Witness Statement.
10.2 By contrast there has not been a public enquiry in the UK into the conduct of UK nuclear tests and their health effects on military and civilian personnel. Official research e.g. by the NRPB has been accountable to Government. Other independent research e.g. by Rabbitt Roff, Busby and others has had limited funding and has been heavily criticised on methodology grounds in comparisons with large scale state or industry funded research programmes.
10.3 These appeals are not a public inquiry. However we have endeavoured to locate and collate as much relevant data as possible, where possible from primary sources. Perhaps other independent researchers will investigate both health and environmental data for the Grapple test series in the future. We hope that the data we have located, and have been refused access to, will be of some assistance to the Tribunal in assessing the environments to which our Appellants were deployed. So far these suggest to us potentially far higher levels of radioactive exposure during and after the UK test series than would appear from the sparse but important records collected in the Claire report.

11. **Ionising Radiation Exposure risks and pathways**

11.1 Dr Ash's report takes an important and professional Radiation Risk assessment approach to the potential ionising radiation exposure pathways faced by Don Battersby and Barry Smith.

11.2 Mr Hallard's report was resourced to do a far more detailed analysis, but was dependent on the data that was made available to him by the SSD. So he courageously attempted to locate fallout risks from Grapple Y on the basis of the Shackleton survey that he considered in detail. As regards fallout from the western side of the collapsing stem his interpretation of a hotspot to the west of the Island is consistent with lower winds from Met Office Charts and from previous NOAA analysis.

11.3 However, without being briefed on the altitude of the main Grapple Y cloud, drifting East, and of intermediate and lower winds blowing back across the island from the East and South East, Mr Hallard seems to have been led away from a more comprehensive assessment of the whole Grapple Y fallout plume. This was likely to spread both East and West of the Island. We note Mr Johnston's concluding remarks in his report dated 23 February 2012 (SB13.37), para 5.3:

"The vast bulk of the debris from Grapple Y, contained in the main cloud at around 55,000 ft, and consisting of sub-micrometre particulates, would have been transported well to the East of the Island, "falling out" progressively over a period of weeks."

12. **Sources: weapon design and deployment issues**

12.1 Gordon's assessment of the UK tests in Australia indicates that relatively low yield tests e.g. the Buffalo series fired at or near ground level can produce serious local and regional fallout with significant external gamma radiation exposures with serious short term consequences on male fertility, sterility, or chromosome damage, and inhalation of lower doses of mainly alpha generating isotopes potentially causing chronic long term exposures to persistent alpha particles of hotspots. Don Battersby's medical history suggests he may have suffered both effects – short term gamma damage to his reproductive tissues, and chronic alpha exposures in his lymphatic system and pancreas.

12.2 In theory air burst weapons should create relatively less local fallout from neutron activated soil, water etc. but as Dr Ash pointed out the entrainment potential of powerful after winds of up to 300 mph may have been seriously under-estimated for Grapple X and Grapple Y.

12.3 If entrainment occurs, as it appears to have done for almost all the Grapple test series, both over land, water or both, then the direction of upper winds at cloud altitude may be a crucial factor in determining cloud direction and fallout plumes.

12.4 The test planners chose almost ideal conditions for Grapple Z2 and Z3 where both upper and lower winds were blowing from the east and likely to take most fallout offshore to the west. Even so they were arguable too close to land and still disturbed clouds of terrestrial material.

13. **Environment: Weather conditions**

13.4 Other more complex weather factors such as humidity, frontal systems, existing cloud patterns, wind sheer and large scale turbulence were contributory factors to potentially higher levels of local fallout.

14. **Short term versus cumulative fallout risks**

14.1 The highest radiation safety priorities appear to have been given to immediate radiation exposure risks to personnel present at the time of detonation, whether on land sea or air, from prompt gamma radiation in the early phase of the explosion, and related types of radiation (UV and heat), followed by potential exposure to radioactive fallout or rainout hotspots. Measurements were mainly focused on short term exposures as measured by film badges and portable detectors. Most of these factors (except random fallout hotspots) were rapidly attenuated by distance from the explosion, shielding, and time (to allow rapid decay rate isotopes to cool down).

14.2 Relatively little attention seems to have paid to cumulative sources of ionising radiation e.g. in soil, surface water, groundwater, plants, birds, animals and fish. But a pre-survey on Malden Island appeared to detect 5x higher than normal uranium concentrations in guano deposits (SB??) i.e. potential concentration of toxins developed through food chains. Dr Ash highlighted potential aerosol contamination on shore from fallout contamination on the sea surface from onshore winds (from the east of the Island).

14.3 Vegetation may captured airborne dust to concentrate gradually in soil, bark or fruit. Inland lagoons would provide natural reservoirs for contamination in water, groundwater and margins. While several environmental surveys were conducted little mention is made of soil or water sampling, and remarkably few fish were tested given that hundreds were reported dead on the beaches and by vessels offshore after test shots.

14.4 Most environmental monitoring, from the time of tests and up to Aspinwall, seemed to concentrate on Gamma detectors. These would be less likely to show long half alpha emitters unless associated with a gamma hot spot. The longer term studies were reasonably concerned to isolate and remediate more tangible hazardous materials like asbestos and radium dials.

14.5 While Claire reports measurements from various short period measuring devices (sticky paper, air pumps, water samples) there seems less concern for accumulating fallout from UK and US tests in the region, cumulatively from over 40 nuclear tests in the region in the two and a half years prior to Barry Smith's arrival. He was in effect deployed to a recent nuclear war zone. Accumulations might be highest inland in vegetated areas that would capture airborne dust as well as contaminated rain. Work or leisure in these areas would be more likely to exposure from re-suspended radioactive particles.

15. Longer terms studies are complicated by subsequent US nuclear tests held in the vicinity of Christmas Island. Environmental survey techniques like tree ring cores have not been referred to in the reports that we are aware of. In effect the personnel who were present during or soon after the UK tests in 1957-58 might be "containers" of fallout traces if retained for example in bone. In this regard the

results of organ testing of test veterans reported in the Redfern Inquiry should be the most comprehensive source of systematic research. How much of that research has been published has not been discussed in these appeals. However if the fallout charts for the Grapple test series are not considered suitable for declassification and disclosure, then the results of isotopic testing on bone and tissue samples that might indicate detectable alpha emitting isotopes from UK nuclear tests are unlikely to be disclosed either.

Conclusions for Battersby & Smith Appellants:

For Don Battersby

The nature and near surface deployment of the weapons used in the four Buffalo tests were likely cause significant ionising radiation exposure risks for any personnel in the local area. In addition Don Battersby's work roles in aircraft maintenance, decontamination and visiting forward areas were likely to expose him to significant sources of external and internal exposures.

His medical history including birth and death of deformed twins just 3 years after participation in the Buffalo test series, his later development of CLL, and finally his diagnosis for Pancreatic cancer would appear consistent with potential acute exposure to significant levels of gamma radiation in his work roles, and later to chronic exposure to internal alpha radiation.

These exposure factors appeared to have been accepted in the original First Tier Tribunal, and by the SSD (SOS) instructions to the SPVA to grant him an award for Pancreatic Cancer as a radiogenic condition attributable to service.

In the light of the exposure issues above and argued in more detail in Dr Ash's report (SB1/2.10) and Don Battersby's medical history we ask the Tribunal to consider that, like his Pancreatic Cancer, there are sufficient grounds to consider that his CLL may have been attributable to the same service as his Pancreatic cancer.

With regard to the potential radiogenicity of CLL we will explore that in a separate section of this Closing Submission.

For Barry Smith

For the Tribunal to consider that Barry Smith's death from Pancreatic Cancer may have been attributable to exposure to ionising radiation during his deployment to Christmas Island requires that we raise the possibility that cumulative radioactive contamination from

UK and other tests in the two and a half years prior to his arrival may have been a serious factor. Also that his extended stay of approximately one year on the island may have increased his exposure to potential sources of internal radiation.

Since Barry Smith was not present at any of the UK nuclear tests the issues of potential acute gamma exposures from prompt radiation or early fallout or rainout hotspots do not arise. However the fact that he was deployed after cumulative fallout or aircraft decontamination from 9 UK tests and at least 20 of 35 US tests held in 1957-1958 requires further consideration.

As regards the potential fallout or rainout from the UK Grapple test series we have indicated serious concern that either:

a) remarkably little fallout monitoring occurred during the Grapple test series and that unlike the Australian tests, minimal local or regional fallout mapping was conducted for the Grapple series. (a Don't Look, Don't Find strategy)

Or

b) That the SSD has deliberately withheld substantial amounts of fallout monitoring data and charts of the fallout plumes for all of the Grapple test series from the Appellants and hence from the Tribunal despite our disclosure requests.

Whichever scenario applies re fallout mapping for the Grapple test series we contend that the photographic evidence indicates:

1) That very little nuclear cloud material crossed the tropopause boundary in any of the Grapple test series except for a small "chmney" seen above the Grapple Y cloud.

2) Consequently that they was a much higher likelihood of local fallout from several tests than the SSD has conceded.

3) That contemporary Met Office meteorological records and charts for surface and upper winds clearly show adverse upper winds at nuclear cloud height for both the Grapple X and Grapple Y test shots.

4) That much of the upper cloud fallout would fall east of Christmas Island, into prevailing lower winds that would carry it back across the Island known as "blow back".

5) That the powerful convention current and after winds below the nuclear fireball in all tests had much greater potential to suck up or "entrain" quantities of moist air, water vapour, and other marine or terrestrial material or both for inshore tests. This is clear in photographs for most of the Grapple test series.

6) That in the largest tests Grapple X and Grapple Y the stem eventually reached down to surface level, and that the upper stem and a larger area of the nuclear cloud appeared to descend while near or over Christmas Island.

The implication of these factors is that far greater quantities of local fallout and/or rainout were likely to affect large areas of Christmas Island.

The absence of reported evidence for larger amounts of fallout is hard to explain with full disclosure of available material. However, while short half life gamma fallout appears to decay rapidly on gamma measurements, any quantities of long half-life alpha emitting fallout e.g. uranium oxides will be a persistent long term internal alpha radiation hazard for people visiting or working in areas where fine uranium oxide particles are re-suspended by vehicle movements, sunlight, wind or work duties. In Barry Smith's case cutting the hair of personnel deployed in many roles and locations he may have been exposed vicariously as well as from his own excursions around the island.

The possibility of suffering no internal radiation exposure in such a contaminated location seems much less likely than the SSDs proposition of no significant exposure.