

Item	Discussion and decisions	Action by
1.	<p><u>Introductions</u></p> <p>The chairman welcomed the representatives of the three laboratories that had taken part in the main testing programme, and invited them to contribute to the discussions of the Board. He also welcomed Mrs Paxton and Mr Plato from the Veterans Policy Unit, who explained that they had responsibility within the MoD for legacy health issues including DU. The chairman reported apologies, and said that the main objectives for this ultimate meeting of the DUOB were to reach a decision on the “independent third party” and finalise both the formal report and the suggested letter to <i>The Lancet</i>.</p>	
2.	<p><u>Minutes of the 22nd meeting</u></p> <p>The previous minutes were approved without alteration.</p>	
3.	<p><u>Matters arising</u></p> <p><u>Action 20.1: Dr Lewis to liaise with Dr Henderson before sending out a revised version of the report to the Board</u> The chairman said that he had discussed this outstanding action with Dr Lewis and agreed that it had been overtaken by events. The matter would not now be pursued.</p> <p><u>Action 20.3: Project manager to approach proposed 3rd party and set up contract</u> This was to be discussed under agenda item 7.</p> <p><u>Action 21.1: Professor Coggon to conduct statistical analysis of results at the end of the programme</u> The analysis had been done and was included in the final report. Dr Busby had also carried out an analysis.</p> <p><u>Action 21.4: Chairman to contact laboratories regarding difference in spiked sample results</u> Professor Parrish said that he had looked briefly at this matter but not reached a firm conclusion. The Board felt that there was no need to pursue it at this stage as the differences were small and did not impact critically on interpretation of results.</p> <p><u>Action 22.1: Professor Hooper to confirm that veterans are content for the RBL to act as the independent 3rd party</u> Professor Hooper said that there was no objection to the RBL’s assuming this role.</p> <p><u>Action 22.2: Professor Coggon to draft a final report upon completion of final sample analysis</u> A report had been drafted and circulated in advance of the meeting.</p>	
4.	<p><u>Testing programme update</u></p> <p>i. The chairman reported that the final results letter had been sent in September 2006, and the retrospective testing programme was therefore now complete. A closing report had been received from the healthcare administration contractor. Professor Coggon said that the programme had been administered very satisfactorily and commended Grosvenor Health for its excellent service.</p> <p>ii. The chairman noted that the completed tables of (anonymised) analytical data had been circulated to Board members and were summarised in his draft report. One</p>	

	<p>sample – 348990 – had proved to be an unusual case. Analysis by the Harwell Scientifics laboratory had shown natural uranium only, whilst NIGL had detected an enriched isotopic ratio. NIGL had carried out three separate analyses of its aliquot and obtained three markedly different results. Subsequently it had analysed the aliquot retained by Harwell Scientifics, and found no indication of enriched uranium. Professor Parrish said his conclusion was that the bottle containing the NIGL sample must have been contaminated with enriched uranium that was not fully mixed with the urine. There was no sign of enrichment in the sample held by the other laboratory, and NIGL’s measurement of ^{236}U was very close to the background level. The chairman said that the result had been reported to the test participant as “no evidence of DU”. The Board agreed that this was appropriate.</p> <p>iii. Professor Coggon said that another unusual situation had arisen in respect of the final batch of five spiked samples from Royal Holloway. Hitherto it had been the practice to take Professor Thirlwall’s gravimetric data as the definitive composition for comparison with the receiving laboratories’ analyses, but for the last set, the RHUL measured data were considered more reliable (this view had been supported in correspondence by Dr Henderson). Professor Thirlwall said that ideally both gravimetric and measured values should always be used, since the gravimetric calculations hinged on a single measurement. However, in most cases the differences were of little practical significance.</p>	
5.	<p><u>Laboratories’ wash-up</u></p> <p>i. The chairman invited the laboratories’ representatives to comment on their experiences of the testing programme and any lessons learned. Professor Parrish said that things had generally run very well, although NIGL had faced a problem in 2005 when the initial large surge of applicants had overwhelmed its capacity and caused a backlog of samples to build up. From the laboratories’ point of view it would have been better to space out the clinic appointments. Nonetheless, liaison with the administration contractor had been good.</p> <p>ii. Mr Holdship said that the Scientifics laboratory had been busy at times, but in general the programme had gone well. Professor Thirlwall said that RHUL had encountered no major problems and commended Grosvenor Health for its excellent liaison. Professor Coggon asked for the Board’s appreciation of the good performance and helpful co-operation of all three laboratories to be minuted.</p> <p>iii. Professor Hooper asked about the measurements made of the ^{236}U isotope. Professor Parrish showed the Board plots he had prepared of the NIGL vs RHUL ^{236}U data, which as expected showed a linear relationship. He noted that some of the spiked samples had contained ^{236}U but with a natural $^{238}\text{U}/^{235}\text{U}$ ratio. Professor Parrish believed that the NIGL method for determining ^{236}U was reliable at total uranium concentrations of 1-2 ng l⁻¹. The technique employed at the Scientifics laboratory was less sensitive for ^{236}U. Professor Parrish stated that in his opinion the absence of detectable ^{236}U in the veterans’ urine samples added important weight to the conclusion that they contained no depleted uranium. He said that in due course he and Professor Thirlwall would like to submit a scientific paper on the measurement techniques. There were no objections to this from the Board.</p>	
6.	<p><u>Destruction of samples</u></p> <p>The chairman said that hitherto the laboratories had been authorised to dispose, after 3</p>	

	<p>months, only of those veterans’ samples that had given rise to a ‘standard negative’ report; others had been retained in case of queries. It was agreed that all remaining samples could be destroyed in mid-December 2006, which would be three months after release of the final result.</p>	
<p>7.</p>	<p><u>Data storage</u></p> <p>a) <u>Independent third party</u></p> <p>i. It was confirmed that the NGV&FA had no objection to the Royal British Legion acting as an independent third party. General Craig pointed out that he had not made the suggestion, but would now consult internally to establish whether suitable arrangements could be made for holding the information. The chairman said that it could be accessed only by the individuals concerned or those acting with their express permission. Dr Busby asked about access to the questionnaire answers for research purposes. Professor Coggon said that he could approach VPU for anonymised data or, with the permission of the individual test participants, the independent third party. However, only the information for those who had consented to their data being used for research purposes could be released through VPU.</p> <p>ii. Mr Jones pointed out that the consent question had referred explicitly to a <i>solicitor</i> as independent third party and suggested that this excluded the RBL. Professor Hooper said that the RBL had a legal department. Mr Williams informed the Board that only 61% of the test participants had consented to the passing of their details to a third party. The chairman said that a higher proportion had agreed to research use.</p> <p>iii. Dr Busby made a verbal request to the Board for access to those questionnaires for which research consent had been given. He gave an assurance that no individually identifiable personal information would be made public or passed on to others.</p> <p><u>Action 23.1: Secretary to authorise Grosvenor Health to release copies of Part B questionnaires with research consent to Dr Busby</u></p> <p>b) <u>Archiving</u></p> <p>The chairman said that Grosvenor Health would hold the test results and questionnaire answers for five years beyond the term of its contract (i.e. until 30 September 2011). The Board had previously said that one year prior to the expiry of that period the MoD should consult the RBL and NGV&FA about the need for longer-term storage. Mr Jones said that the advice received by VPU was that medical records should be retained until the 100th anniversary of the birth of each individual. The MoD would prefer to make long-term arrangements soon, as future staff might not be familiar with the subject. Professor Coggon said that consultation could go ahead before 2010, but the solution pursued would have to be acceptable to all parties, and in particular to the organisations representing veterans. Dr Levy suggested that VPU seek guidance from the Health & Safety Executive as similar issues arose in relation to transfer and archiving of occupational health records.</p>	<p>Secretary</p>
<p>8.</p>	<p><u>Final report</u></p> <p>a) <u>Content</u></p> <p>i. The chairman stated that the primary purpose of the final report was to archive the experience of the DUOB, not to answer scientific questions about patterns of exposure to DU. The report should be principally a factual account of what had been done. The</p>	

draft text was based closely on what had previously been agreed by the Board, most of which had already been made public on the website. The interpretation of analytical measurements used the same wording that had been agreed for use in the results letters.

- ii. Professor Coggon said that early comments from Board members had been included in the second draft of the report and others would be incorporated in a revised version. Professor Spratt said he thought it was important to state explicitly that no ^{236}U had been detected in the veterans' samples. He believed that all DU penetrators contained ^{236}U . Dr Busby said that ^{236}U was a component only of uranium that had been in a nuclear reactor. Both depleted and enriched uranium produced directly from ore would contain no ^{236}U .
- iii. Professor Parrish said that he and Professor Thirlwall knew of a few analyses of DU penetrator metal, all of which showed ^{236}U in the range 20-40 ppm. Commercial uranium standards, and hence the dopant added to spiked samples, were of a different composition from penetrators and contained more ^{236}U . However, he had seen no evidence of DU penetrators totally lacking ^{236}U . He believed that it would be detectable even in a sample that was only marginally positive for DU.
- iv. Dr Busby said that the question of ^{236}U was pivotal and could affect the whole validity of the testing programme. Professor Parrish reported that NIGL had analysed a sample from the biological monitoring programme that was positive for DU. The uranium content appeared to be penetrator DU, and ^{236}U was detected. No ^{236}U was detected in any of the veterans' samples from the retrospective testing programme.
- v. The chairman said that substantial written responses to the second draft report had been received from Dr Busby and Professor Hooper. The Board proceeded to discuss these responses at length.

b) Dr Busby's paper

- i. Several aspects of Dr Busby's paper were criticised, principally by Professor Spratt and Professor Coggon. Dr Etherington disagreed with Dr Busby's assertion that no experiments had been conducted on particulate forms of oxides of uranium that could be produced by the impact of a DU projectile, pointing to the US Capstone study. Professor Spratt said that earlier work done by NRPB had made use of data on such particles. Professor Coggon challenged Dr Busby's statement that the DUOB had not considered the possibility of enriched uranium in the UK environment.
- ii. The chairman said that the findings of the civilian normative values pilot study, which had involved 25 in-patients at an Edinburgh hospital, could not be considered representative of the UK population. Its purpose had been specifically to compare the reliability of data obtained from 24-hour and 'spot' urine samples.
- iii. Dr Lewis pointed out that the statement in 4.1 that ^{236}U was an indicator for enriched uranium was incorrect. Dr Busby agreed this was a mistake.
- iv. Professor Coggon said that a $^{238}\text{U}/^{235}\text{U}$ atomic ratio above 142 had not been the sole criterion for judging the presence of DU in a sample. A negative report also required that neither laboratory had a *suspicion* of DU. Professor Parrish confirmed that NIGL had detected DU in spiked samples with a $^{238}\text{U}/^{235}\text{U}$ ratio below 142. The judgment was made on the basis of the measured ratio and its calculated uncertainty, the confidence band being the central value plus or minus two standard deviations of each

individual measurement. He added that the 142 threshold arose from the laboratory pilot studies, but NIGL had been able to achieve superior precision. Dr Busby agreed to amend his wording.

- v. Professor Hooper felt that some test participants who were told their urine contained no DU could in fact have been exposed to it. Professor Coggon stressed that a threshold ratio of 142 was not the sole criterion. The results letters had made clear that the possibility of DU exposure below the limit of detection could not be excluded. The Board had taken extreme care to be accurate in its statements, and the wording had been considered carefully by members before it was used.
- vi. The chairman said that his other major criticism of the Busby submission was that it assumed a uniform experimental uncertainty for all measurements. This was incorrect because the uncertainty depended on the total uranium content of the sample. Professor Parrish said that neither of the laboratories had found evidence of DU in the veterans' urine. This did not prove that it was absent, but there was no evidence for its being present. Dr Busby said that he would consider all the comments, for which he was grateful, and adjust his paper as appropriate.
- vii. Dr Busby claimed that his statistical analysis of the test measurements clearly showed the presence of enriched uranium in the UK population. Professor Thirlwall said that it was necessary to consider the individual experimental error on each measurement: it was not valid to draw conclusions from the standard deviation of the overall set of data. Dr Busby argued that this was possible with a sufficiently large number of samples. Professor Coggon said that a population standard deviation could not be applied to each individual result.
- viii. Dr Busby maintained that the statistics proved the presence of both depleted and enriched uranium. Professor Spratt said that the work was flawed. Professor Parrish said that the test of 'undetected' DU lay in the ^{236}U isotope. No ^{236}U had been detected. In his opinion, that proved that Dr Busby's view could not be correct.
- ix. The chairman said that a very peculiar set of circumstances would have had to occur for Dr Busby's conclusions to be true. Dr Busby said they required only DU that contained no ^{236}U , and suggested that others rework his calculations. He asserted that contamination by DU could not be ruled out. The chairman agreed in principle, but said the scenario was so implausible that it could be dismissed.
- x. Professor Spratt disputed Dr Busby's claim that the total urinary uranium concentrations found in the Op TELIC biomonitoring programme were "significantly higher" than in the general population. Professor Coggon said that differences in diet led to substantial 'normal' variation.
- xi. Dr Busby said that he would like the analytical limits of detection to be stated more explicitly in the DUOB final report.
- xii. Professor Spratt referred to the findings of the King's College Op TELIC DU sub-study. Since Operation TELIC was still comparatively recent and a large volume of DU weaponry had been used, he personally had expected to find evidence of exposure. In fact, of the 369 research volunteers, only four showed isotope ratios above 142 and the highest measured ratio was only 147. There was therefore no evidence of substantial exposure, and this was entirely consistent with the test programme findings. Dr Hall said that the analyses could detect only excreted DU, and inhaled particles might be insoluble. Professor Spratt said that there would always

be a soluble fraction.

xiii. Dr Busby suggested that detection of DU could be avoided by military use of natural uranium weaponry.

c) Professor Hooper's paper

i. Professor Hooper said that his greatest disappointment had been the Board's unwillingness to look at biological outcomes of DU exposure. The chairman said that the DUOB had considered the examination of lung tissue and endorsed it as potentially valuable, but unfortunately lung autopsy was not practicable as a routine test. Professor Hooper commented that no procedure was in place automatically to examine the lungs of veterans who died. With regard to chromosome aberration, the chairman said the majority view was that the phenomenon was not sufficiently specific to DU. It could have been explored as a possible biological effect, had evidence of DU exposure been found, but it was not satisfactory as a biological marker of exposure. Professor Hooper said that 13-14 years after the Gulf war had been too late to launch a urine test. He felt, however, that there would still be value in chromosomes research.

ii. Dr Busby said that he thought the DUOB had become too dependent on the ICRP biokinetic model. In his view, its assumptions were unproven. Professor Coggon said that there was empirical evidence in support of solubility fractions.

iii. Dr Busby stated that he and Professor Hooper did not consider the DUOB had fulfilled its remit. No suitable retrospective test for DU exposure had been developed. He felt that other techniques should be mentioned in the final report.

d) Points of disagreement

i. Dr Busby said that he did not accept the ICRP model and disputed the statement in the draft report that none of the test participants had shown detectable DU. Professor Hooper felt that the testing programme had been a great achievement, but wanted the limits of detection to be stated and the difference in analytical sensitivity between the two laboratories to be highlighted. He objected to the assertion that diet might be responsible for the wide variation in urinary uranium concentrations. The chairman said there was evidence in the scientific literature of variable uranium excretion due to diet. Professor Hooper refused to endorse the statement.

ii. Dr Busby reported that his geographical analysis had shown no relationship between total uranium excretion and area of residence except in the vicinity of BNFL Sellafield, where levels were higher than elsewhere. The dissolution of bone mass in the elderly and fluoridation of drinking water were mentioned as factors that might affect uranium excretion. The chairman agreed to add "other environmental factors" to the statement about diet. Dr Hall said he did not think diet could be an important factor, as most people in the UK today ate food from the same central suppliers.

iii. Dr Busby suggested a minority report. The chairman said this was acceptable provided it was made clear which members did and did not subscribe to the minority view. His priority in the majority report was to ensure that the Board's work was put on record.

iv. Dr Busby said that the wider discussions of the DUOB should be reported. The conclusions drawn from the testing programme were based on the ICRP model, which he believed to be incorrect. He also thought that the claims about "mainstream

<p>medical opinion” were no longer true. The chairman said that the Board as a whole had not reached any conclusion on the broader matters to which Dr Busby referred. Professor Spratt said that it was unnecessary to consider the broader aspects of the subject because no evidence of DU exposure had been found.</p> <p>v. The chairman sought the views of other Board members. General Craig said he considered the mixed DU/EU suggestion totally implausible and thought there could be no link between the levels of DU exposure that were possible and veterans’ reported health problems. He added that the screening programme had been prompted by Durakovic’s report of very high urinary DU levels; what had actually been found was very different.</p> <p>vi. Dr Lewis said that any challenge to current thinking demanded a great deal of evidence, and he saw no justification for rejecting the ICRP model. He expressed concern about Dr Busby’s motives. Surg Cdre Baldock said that the original questions had been: “Can DU exposure be detected?” and “How does DU exposure affect human health?” The answer to the first was “yes”, and the second was now irrelevant. He felt that a minority report was the only practical way to reconcile the different views on the Board.</p> <p>vii. Dr Hall felt that the findings of Professor Parrish’s research in Colonie, NY contradicted the majority DUOB view. Professor Parrish did not agree, saying that could be true only if all the inhaled particles were insoluble. Dr Hall said that the absence of evidence of DU exposure did not mean that no exposure had occurred. The chairman said that in his view no significant exposure had occurred. Dr Hall said that he would support a minority report.</p> <p>viii. Dr Busby pointed out that most of the chairman’s draft was factual and uncontentious. Those elements need not be repeated in the minority document. Professor Coggon said that it need cover only the points of disagreement. Professor Hooper said that he was content with this.</p> <p>ix. Dr Etherington felt that the best approach was to produce a single report with a minority annex. Dr Levy said that aspects on which members had previously given their agreement, such as the terms of reference of the DUOB, should not now be questioned. The minority annex should concentrate on interpretation and exposure assessment.</p> <p>x. The chairman summed up by saying that the Board would release a majority report with dissenting statement. He added that the minority view had certainly influenced the conduct of the testing programme. A minority report was not a problem in this case since the DUOB was making no recommendations. The chairman would try to circulate a final draft majority report by the end of November, and Dr Busby would lead on preparing the minority statement. Dr Busby said one point on which all members of the Board could agree was that there had been no “skulduggery” by the MoD in running the programme.</p>	
<p><u>Action 23.2: Chairman to circulate final draft majority report by end of November</u></p>	<p>Chairman</p>
<p><u>Action 23.3: Dr Busby to provide agreed minority statement in January 2007</u></p>	
<p>e) <u>Distribution of report</u></p>	
<p>i. The chairman proposed that the report be sent to the Minister, all past members and observers of the DUOB, the contractors involved in the testing programme, and</p>	<p>Dr Busby</p>

	<p>academic researchers working on aspects of Gulf veterans' illnesses. It should also be made public on the DUOB website. Other suggestions for recipients should be sent to the secretary.</p> <p>ii. Mr Jones said that for reasons of protocol, the report ought to be sent to the Minister first with recommendations for further distribution. The chairman responded that the Minister could have the first copy but not a veto on publication, since the DUOB was an independent committee. Professor Spratt asked for a copy to be sent to UNEP and Dr Busby nominated the New Zealand Government.</p>	
9.	<p><u>Draft letter to <i>The Lancet</i></u></p> <p>The chairman explained that the letter would be from Professor Spratt and himself, rather than from the whole Board. Its purpose was to draw attention to the DUOB final report. Dr Busby said he was not content: the draft letter gave the impression that its conclusions were those of the full DUOB. He did not agree that the urine test was "sufficiently sensitive" and considered the statement that exposure was "relatively uncommon" to be misleading. Professor Coggon suggested that Dr Busby write his own letter to <i>The Lancet</i>. Dr Busby agreed to do so, but was not optimistic about the chances of publication. He said that the chairman should state in his letter that not all members of the Board supported the conclusions.</p>	
10.	<p><u>Scientific issues</u></p> <p>a) <u>King's College report on DU sub-study</u></p> <p>i. Professor Coggon briefly explained the background and sampling method of the study, which had been designed to compare DU exposures between occupational groups rather than to give advice to individuals. Professor Spratt emphasised that those groups thought to be at greatest risk of DU exposure on Op TELIC had been included. No evidence of exposure was found. Dr Lewis pointed out that since the Gulf war, British troops had received extra training on how to reduce the risk of exposure to DU.</p> <p>ii. Dr Busby noted that there was some difference in total uranium concentrations between the study sample and those TELIC personnel whose urine had been tested in the biological monitoring programme. Professor Spratt said that much of the research sample was at bases in Germany. Dr Lewis informed the Board that because of the highly saline groundwater in southern Iraq, UK forces there were drinking bottled water purified by reverse osmosis. This was deionised and so had negligible uranium content.</p> <p>iii. Professor Hooper said that the DUOB should have conducted the study. He would like the samples to be re-analysed at NIGL.</p> <p>b) <u>Bellis <i>et al</i> paper on airborne contamination of tree bark</u></p> <p>Dr Busby said that this paper provided further evidence of enriched uranium in the UK natural environment. Particles were present in the air and most human exposure occurred by inhalation. Therefore any test based on the measurement of atomic ratios of isotopes near the limit of detection was, in his view, of questionable value.</p> <p>c) <u>Keith Baverstock ICBUW presentation</u></p> <p>Professor Hooper said that the presentation tended to support his criticisms of the chairman's draft report. It was agreed that a copy of the final version of the report</p>	

	would be sent to Dr Baverstock.	
11.	<p><u>Any other business</u></p> <p>i. Professor Thirlwall asked about storage of the analytical data. The chairman said that it was held by the secretariat as a master consolidated spreadsheet. Some members felt that the spreadsheet should be published on the website. There was discussion as to whether anonymous analytical data could be disclosed if the individual concerned had not consented to its use for research purposes. Professor Coggon said it would be safer to use only data for which consent had been granted. Professor Parrish requested the opportunity to check the spreadsheet against his records in case of errors.</p> <p><u>Action 23.4: Secretary to send consolidated spreadsheet to the analytical laboratories for final checks</u></p> <p><u>Action 23.5: Secretary to inform DUOB members of any corrections to the spreadsheet</u></p> <p>ii. Dr Busby mentioned his paper on analysis of soil debris samples from fresh bomb craters in the Lebanon. He said there was clear evidence of the use of enriched uranium munitions there, and felt that this raised questions about the possibility of their use by coalition forces in Iraq. Professor Parrish offered to analyse a soil sample for ²³⁶U.</p> <p>iii. Professor Thirlwall said that before averaging a set of atomic isotope ratios in a population study, they should be weighted according to the amount of uranium present in each measurement. Professor Coggon said he was not convinced that this approach was appropriate in this case, as it would give undue weight to outliers. He added that there were arguments on both sides.</p> <p>iv. The chairman proposed that his communication with the Minister should include a recommendation to disband the DUOB, as its work was now complete. This was agreed without dissent.</p> <p>v. Professor Coggon said that he would like to record his thanks to the three laboratories and to all the other contractors involved in the testing programme. He also wanted to thank VPU and the DUOB secretariat, particularly the project manager since July 2003, Charles Williams. Finally, he was grateful to his fellow Board members for the great deal of common ground they had managed to find.</p> <p>vi. Professor Spratt voiced the gratitude of the DUOB to Professor Coggon for his skilful and fair chairmanship.</p>	<p>Secretary</p> <p>Secretary</p>

Distribution

All members
All observers