Depleted Uranium -
Safety Guidance to UK Armed Forces and MOD Civilians

Produced by the Gulf Veterans' Illnesses Unit, Ministry of Defence, 15 March 2001

Introduction

1. Recent media coverage has again raised public awareness of the hazards of Depleted Uranium (DU), a metal derived from naturally occurring uranium. Uranium naturally occurs in three different forms, known as isotopes. These isotopes are uranium-238 (99.3% by weight), uranium-235 (0.7% by weight) and uranium-234 (0.0055% by weight). Natural uranium has to be processed for use in nuclear weapons and some types of nuclear reactors to increase the concentration of uranium-235, the main fissile isotope. This process is known as enrichment. A by-product of the enrichment process is DU which contains virtually no uranium-234 (0.001% by weight) and a reduced amount of uranium-235 (a maximum of 0.2% by weight) and about 99.8% uranium-238.

2. Radiation is emitted in three different forms known as Alpha, Beta and Photon (ie Gamma and X-ray) radiation. Alpha radiation is characterised by heavy, slow moving particles that have little energy and hence little penetrating power. Alpha particles are stopped by a sheet of paper and most will be stopped by the dead outer layer of skin. Beta particles have slightly more energy and can typically penetrate about one centimetre into the body, but even so Beta particles can still be stopped by a few tens of centimetres of air. Photons have the greatest energy travel and can pass through the body. Uranium is predominantly an alpha particle emitter. DU is about 40% less radioactive than uranium of natural composition as a result of the removal of most of the more radioactive uranium 234 and uranium 235. Uranium and DU are chemically classed as 'heavy metals' similar to tungsten, cadmium and lead. DU has toxicological effects identical to natural uranium and similar to the other heavy metals.

3. DU ammunition was introduced into UK service because of its ideal qualities as a Kinetic Energy penetrator, capable of defeating the most modern battle tank armour. DU is also pyrophoric – it burns at high temperatures when striking hard targets. At present no other material achieves the same military capability as DU. DU also has applications away from munitions in both the military and civilian fields. It is used as radiation shielding similar to the way lead is used and also used as counterbalance weights in some military and civilian aircraft. In solid form DU presents little radiological and chemical hazard and is safe to handle with minimal protection. This is because the radiation dose rate decreases rapidly with increasing distance from the surface. Troops could remain in tanks loaded with DU ammunition for over 1500 hours per year before the statutory whole body radiation dose limit for employees would be exceeded.

4. However, UK legislation exists to provide safety guidance for the protection of workers and the general public from radiological and chemical hazards, including DU. The purpose of this paper is to demonstrate how this legislation is applied throughout the Ministry of Defence where there is a recognised risk of exposure to DU.

Scope

5. The paper covers the MOD's extant safety guidance provided to employees involved in the use, maintenance, storage, transportation, testing and research of DU related military specific systems. DU is currently used in 120mm tank ammunition, RN Phalanx 20mm close in weapon system ammunition and aircraft counter-balance weights (some civilian aircraft such as the older Boeing 747s also use DU counter-balance weights). The paper illustrates the hierarchy of documents and supplementary advice associated with the management of DU in MOD and provides a brief summary of what the guidance entails. The documents themselves (some of which have previously been made public and some of which are classified) are not reproduced as part of this paper since they are voluminous. A full list of the documents referenced can be found at the end of this paper.

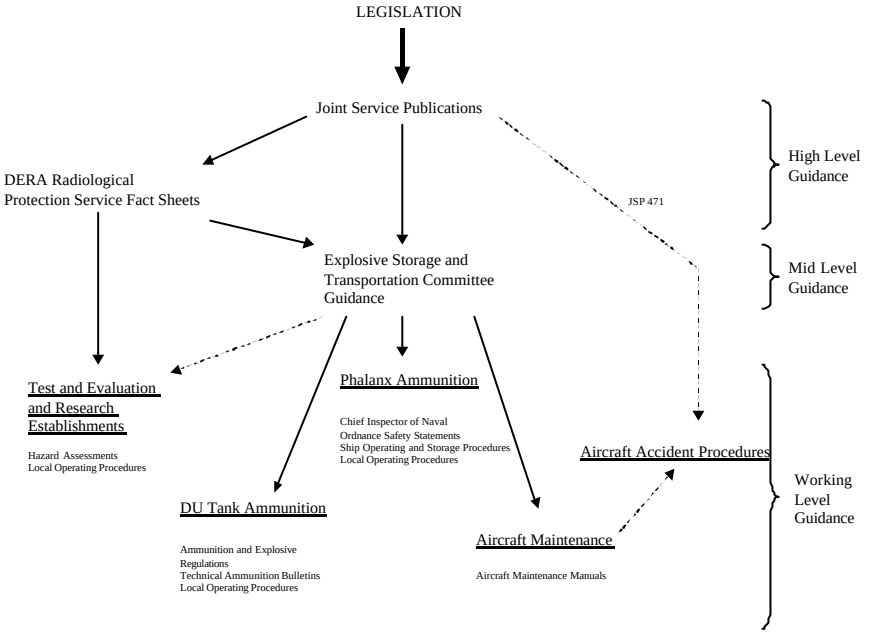
6. This paper does not cover the non-military specific use of DU, such as radiation shielding. In addition it does not cover advice given by MOD to those who would not come into contact with DU in the course of their normal duties, but who may meet it in extraordinary circumstances, such as

personnel deployed on operations. The Ministry of Defence published documents about warnings given to troops on operations on 25 January 2001.

7. The MOD operates a hierarchy of information covering the management of DU. High level guidance is promulgated in the form of **Joint Services Publications (JSPs)** which set out the broad regulatory framework covering the use of all hazardous material. These are supplemented by **DERA Radiological Protection Service (DRPS) Fact Sheets** which give more specific, but still high level, guidance on DU. Whilst available to all staff, these documents would typically be used by Headquarters staff or specialist environmental protection officers.

8. Flowing from the JSPs and DRPS fact sheets are **Explosive Storage and Transport Committee (ESTC)** guidance papers which provide more specific advice on management procedures associated with the operation of DU. ESTC guidance papers are typically used by senior commanders and base commanders at locations where DU is stored.

9. At a working level, guidance is promulgated to front line troops via **Technical Ammunition Bulletins** (for tank ammunition) and **Safety Statements** (for Phalanx ammunition). These are supplemented by local standing orders which cover operating procedures at specific locations, such as on board a ship. Aircraft maintenance is covered by **Aircraft Maintenance Manuals** which detail maintenance procedures for aircraft with DU counter-balances. This hierarchy is illustrated in the following diagram.



Overarching UK legislation and High Level MOD Guidance

10. All MOD activities involving DU in the UK are either subject to UK legislation covering radiation protection or, where UK Statutory regulations are not applicable to, or enforceable on MOD establishments, MOD undertake by agreement with the Government Departments concerned that the principle and spirit of the regulations are to be followed. UK principles and practices are also applied overseas unless there are more stringent host country requirements. Regulations that might be applicable include the Health and Safety at Work Act 1974, the Environmental Protection Act 1990, the Radioactive Substances Act 1993, the Control of Substances Hazardous to Health Regulations 1999 and the Ionising Radiations Regulations 1999.

11. MOD guidance on health and safety is set out in **Joint Service Publication 375, the MOD Health and Safety Handbook (Reference 1)**. As already indicated DU is classified as a heavy metal

and as such falls under the Control of Substances Hazardous to Health Regulations 1999. JSP 375 provides guidance to staff on how to apply the COSHH regulations.

12. The radiological threat posed by DU is covered in **Joint Service Publication 392 "Instructions for Radiation Protection" (Reference 2)**. A list of current statutory radiation protection requirements is included within JSP 392 and, for reference, this list is attached at Annex A to this paper. JSP 392 is designed to provide further instructions and guidance for MOD staff on how to implement this legislation with respect to military establishments and defence agencies. The document has four sections:

a. Introduction: a general description on the background and use of the publication.

b. Radiation Protection: an outline of the general radiation protection requirements for ships and units holding sources of ionising radiation.

c. Radiation Safety: a description of the detailed requirements for the storage, use and transport of encapsulated radioactive sources, articles containing radioactive materials, unsealed radioactive substances and equipment capable of emitting ionising radiation. Chapter 48 of this section refers to DU.

d. Non-ionising Radiation: instructions for the protection of personnel against hazards arising from radio frequency emissions ultraviolet radiations, lasers and microwave ovens.

In addition, JSP 392 establishes the MOD lead branch for radiation protection policy and standards as the Directorate of Safety, Environment and Fire Policy (D SEF Pol). It also establishes DERA Radiation Protection Services (DRPS) as the main Departmental Radiation Protection Adviser and initial point of contact for further guidance.

13. Chapter 48 of JSP 392 deals with the specific safety arrangements required for the use of DU. The chapter covers detailed legislative requirements for storage, transport and working with DU. JSP 392 is promulgated to those whose duties might involve contact with DU via a hierarchy of more detailed rules and advice detailed below. JSP 392 has been made public in response to a Parliamentary Question from the Countess of Mar. A copy of this JSP was placed in the Library of the House in February 1998.

14. DERA Radiation Protection Services have also issued two fact sheets concerning DU. These have been distributed to all Radiation Protection Advisers and Supervisors, and to all units which hold DU, and provide guidance on DU, its hazards, methods of detection and safety precautions. Fact Sheet 16 also contains supporting radiation dose calculations.

Reference 3. DRPS Fact Sheet No 15 – Depleted Uranium dated 1 August 2000.

Reference 4. DRPS Fact Sheet No 16 – Depleted Uranium Rounds dated December 1998.

15. Regulations covering the transportation of dangerous goods are covered in two documents. **Joint Service Publication 445 "Transport of Dangerous Goods by Road, Rail and Sea" (Reference 5)**, refers specifically to DU in Section 4 and 17, and **Joint Service Publication 335 "Dangerous Air Cargo Regulations" (Reference 6)** refers to the transportation of DU by air.

16. Where large quantities of DU (i.e. greater than 1 tonne) are being transported, Nuclear Accident Response Organisation (NARO) teams are put on standby to reduce the response time to any incident. Their procedures are set out in **Joint Services Publication 471 "Defence Nuclear Accident Response" (Reference 7)** and in the **Royal Air Force Nuclear Accident Response Organisation Manual 4th Edition AP110A-0103-1A1 (Reference 8)**, which provides the local advice on the provision of NARO cover, readiness and the initial response to an accident involving the transportation of DU.

Mid Level MOD Guidance

17. The Defence Ordnance Safety Group (DOSG) was formed on 2 October 2000 to bring together a number of discrete organisations with responsibility for the safety of ordnance, munitions and explosives (including DU) across the MOD. The DOSG was formed to provide a more efficient safety management system for ordnance, munitions and explosives. The DOSG supports the Explosives Storage and Transport Committee (ESTC) which provides guidance on all aspects of the storage and transportation of explosives through the publication of Guidance Notes and Prescriptions. Those covering DU are produced in line with DRPS advice and JSP 392 and promulgated to the single services who convert the standard guidelines into detailed regulations and working practices. There are four ESTC documents which cover DU. These are:

Reference 9. **ESTC Guidance Note 1 - Depleted Uranium Ammunition.**

Reference 10. **ESTC Guidance Note 5 - Contingency Planning for Accidents/Incidents involving DU Ammunition.**

Reference 11. **ESTC Prescription No 4 - covering DU Tank Ammunition.**

Reference 12. **ESTC Prescription No 5 - covering Phalanx Ammunition.**

18. Other ESTC prescriptions have existed in the past to cover other specific DU munitions, including those held by the US in the UK, but these have been withdrawn as the munitions were withdrawn from the UK. The US has never fired DU ammunition in the UK.

19. As already indicated, the creation of DOSG has also brought together a number of other functional groups that provided specific advice on the management of DU. These were known as the Ordnance Board (OB), which provided specific advice and guidance on land service munitions safety, the Chief Inspector of Naval Ordnance (CINO) and the Naval Magazine Safety Committee (NMSC), which together covered the safety and regulation of naval ordnance. The guidance from these organisations is extant (and is discussed in the following section).

20. In June 2000, the Ordnance Board (as it then was) consolidated all relevant information for tank ammunition into a single comprehensive document, covering storage, transportation and firing hazards associated with DU ammunition. The document was written in conjunction with DRPS:

Reference 13. **President's Letter 03/00 Safety Precautions for Operating with Depleted Uranium (DU) Tank Ammunition VP(P)/OB/B/6/7/2 dated 23 June 2000.**

The document covers DU's potential hazards, the need for trained Radiation Protection Advisers and Radiation Protection Supervisors, personal protective measures, the need for instruction and training, the role of the medical officers, the requirement for local rules and contingency plans and risk assessments, dosimetry requirements for tank crews, the need to maintain records of gun barrels that have fired DU, precautions to be taken in the event of DU being found in these barrels, and accident response arrangements. A summary of its safety guidance and procedures is at Annex B to this paper. This advice was promulgated to the Permanent Joint Headquarters and throughout the Army (including to HQ Royal Armoured Corps and HQ Royal Electrical and Mechanical Engineers) as "**LAND/CESO 7377 of 14 August 2000" (Reference 14**).

Task Specific MOD Guidance

21. Specific DU related activities may include storage and transportation, test firing and evaluation, aircraft maintenance and research. Each activity and the extant local rules is presented in greater detail below.

Use, Storage and Transportation of DU Tank Rounds

22. Guidance on the procedures for firing DU tank ammunition is included in the 'training to arms' courses that tank crews must complete before joining an operational regiment. Similarly EOD

crews and REME technicians are briefed on the procedures for dealing with DU as part of their routine training.

23. In accordance with Reference 13, all units have at least one trained Radiation Protection Supervisor who is available to provide local advice on DU. This system is supplemented by Army Health and Safety Roadshows which cover the whole Army at least once every 2 years and which brief on issues associated with DU. Guidance on individual types of ammunition in service with the Army, and safety procedures associated with their use, are contained within the Ammunition and Explosives Regulations (AER) and Technical Ammunition Bulletins.

24. Current TABs, which refer to DU are listed below:

Reference 15. TAB 6/2503 (C) (2nd Edit) –Shot 120mm Tank APFSDS with Depleted Uranium dated September 1999. This document provides a technical description of the shot. It contains a health risk warning, which states that the handling of unfired penetrators with bare hands should be avoided whenever possible. It recommends the wearing of gloves and sets limits for the number of hours when handling penetrators without gloves is permissible.

Reference 16. TAB AER/3097 (2nd Edit) – Special requirements on the storage and transportation of 120mm TK APFSDS ammunition containing Depleted Uranium dated August 2000. This TAB brings together the relevant advice from JSP 392 and the ESTC documents, which relate to storage and transportation of DU Tank rounds. It covers the legal requirements for hazard assessments and environmental and personal monitoring which are laid down in JSP 392. Advice on fire fighting methods is also contained in this TAB with recommendations for evacuation distances, fire fighting and dealing with damaged ammunition. In such cases, self-contained breathing apparatus or service respirators are recommended. An annex to the TAB contains the detailed instructions for the transport of DU. This annex brings together the essential rules from JSP 445 and ESTC guidance notes, giving the appropriate references.

Reference 17. TAB 21/3107 – Clearance of Armoured Fighting Vehicles. The third TAB concerns the clearance of Armoured Fighting Vehicles and lists DU as one of a number of risks inherent in this task. The TAB references the other related TABs and the AERs, as well as JSP 392. The TAB recommends an initial assessment for the presence of DU and describes the recommended equipment for this task. When engaged in the clearance of Armoured Fighting Vehicles, the TAB recommends that EOD operators wear a service respirator and a full NBC suit as well as two pairs of gloves until the presence of DU is positively discounted. The reliance on a service respirator is in recognition of the greater risk faced by specialist EOD staff when entering or working for protracted periods in vehicles hit by DU rounds.

Reference 18. TAB AER/3074 – Advice on the storage and transport of DU ammunition and the clearance of DU contaminated vehicles on operational deployments dated June 1999. The final TAB provides detailed advice on the Field Storage and Transportation of DU Tank rounds, which is not currently contained in AER. The TAB is essentially a precursor of TAB/AER/3097, but has additional details on siting of DU stocks on operational deployments. The TAB advises that DU ammunition should be stored down wind of the main storage site and gives additional guidance on the minimum safe distances for storage. The guidance for operational storage differs from TAB/AER/3097 only in that it takes additional account of the risk of fire and accidental damage, which will be greater under operational conditions. An additional section covers the operational clearance of DU contaminated vehicles and supplements **AER Vol 3 Pam 21 Part 3 Section 5 Annex H – EOD Procedure 8 (Reference 19).** The TAB again recommends the use of an NBC suit and service respirator until the presence of DU has been ruled out.

25. DU tank munitions are stored at Defence Munitions Kineton in Warwickshire and Defence Munitions Longtown (near Carlisle). As well as the TABs referenced above local site specific advice is produced and circulated as standard operating procedures. These cover local task and site specific advice such as contingency plans.

Reference 20. **Kineton Station Standing Operating Procedure No 72, Radiation Safety dated September 2000.**

Reference 21. **Kineton Station Standing Operating Procedure No 73, Contingency Plans for Accidents Involving Ammunition containing Depleted Uranium dated September 2000.**

Reference 22. **Kineton Senior Ammunition Technical Officer Technical Instruction No 9, Handling Depleted Uranium Ammunition dated February 2000.**

Reference 23. **Defence Munitions Longtown Standing Orders Part 2.1.6, Annex A, Appendix 3 and Appendix 6. Orders for the Storage of Depleted Uranium ammunition and instructions for using Radiation Monitoring Equipment.**

And, in accordance with JSP 392, both Kineton and Longtown have completed Special Hazard Assessments.

Reference 24. **Special Hazard Assessment for the Use and Storage of Depleted Uranium at Kineton, DRPS Report 55/99.**

Reference 25. **Special Hazard Assessment for the use and storage of Depleted Uranium at Longtown, DRPS Report 56/99.**

Use, Storage and Transportation of Royal Navy Phalanx 20mm Ammunition

26. The operation of the Phalanx close in weapons system is governed by a number of documents, including the weapon's operating drills and the storage of ammunition. Ship standing orders and operator maintainer training at HMS Collingwood fully reflect the hazards and safety instructions outlined in the drill book at BR8475(2C). In brief, protective clothing and leather gloves are to be worn when handling DU ammunition. Personnel must log into and out of the magazine and three dosimeters monitor the environment of the magazine. These are sent off and read by the DRPS every three months. In addition, all Phalanx section personnel have personal dosimeters, which are also sent off every three months for monitoring.

Reference 26. **BR8475(2C) Close in Weapons System Phalanx – CIWS(1) Block 1 &1A.** This contains the operating instructions and drills for the Phalanx System.

Reference 27. **Certificate of Safety for Shipborne Munitions for 20mm Phalanx Ammunition dated September 1999.** This document is the authorisation for specific ships to embark 20mm ammunition.

Reference 28. **Ship Standing Orders.** These cover ship specific procedures and, if appropriate, will detail the precautions and hazards associated with DU. All new personnel are required to sign that they have read the SSOs within 14 days of joining a ship.

27. As previously stated, prior to the creation of DOSG, the CINO and the NMSC had responsibility as the approving authority for DU in the Royal Navy, providing safety statements and certificates for the use, storage and transportation of Phalanx ammunition. Current documents are:

Reference 29. **CINO Safety Statement No 1020 dated August 2000.** This document is the formal safety assessment for the 20mm Phalanx ammunition.

Reference 30. **BR1029(15) Chapter 8 Section 2.** This document is a Naval Base Support Agency publication. It is based on JSP 392 and the ESTC documents as well as supplementary advice from the CINO senior scientist. It gives details concerning the general stowage and handling requirements for DU ammunition at sea.

Reference 31. **STO(N) Standing Orders.** This document localises and amplifies Reference 30. All staff on RFAs are required to read the standing orders.

Reference 32. **BR 862 Vol 4 dated December 1998.** This is the Ship Explosive Store Safety Instruction and covers all aspects of the explosive, toxic and radiological hazard passed by Phalanx DU ammunition aboard ship.

28. In addition to this materiel on Phalanx, **CINO SAFE 1180 dated May 1999 (Reference 33)** covers the safety assessment for the carriage of CHARM 3 DU tank rounds at sea.

29. DU Phalanx ammunition is stored at Defence Munitions Dean Hill. The site has local radiation safety orders and a Special Hazard Assessment.

Reference 34. **Defence Munitions Dean Hill Local Radiological Orders dated 20 March 2000.**

Reference 35. **Special Hazard Assessment for the Use and Storage of Depleted Uranium at Dean Hill, DRPS/MRG/21083/Dean/RM dated 24 January 2001.**

Defence Munitions Gosport is used as a forward loading point for ships equipped with the Phalanx weapons system and has its own site specific radiation safety orders.

Reference 36. **Defence Munitions Gosport Health and Safety Procedures 014, Radiation Safety Orders dated January 2000**

Aircraft Maintenance

30. Depleted Uranium has been used to provide counterbalances to aircraft flight controls in both civil and military aircraft. In the civil sector many Boeing 747s have DU counterweights and of the UK military aircraft fleet, both TriStars and Hercules use DU for this purpose. There is therefore a potential risk to tradesmen working on these aircraft during routine maintenance. The hazards of working on DU are highlighted in a series of Aircraft Maintenance Manuals and in the Safety and Maintenance notes. Specific publications are listed below:

Hercules C130 Aircraft

Reference 37. **AP101B 0701/03 – 1G Sect VI para 6-19 (1) to (4) inclusive Hercules C Mk1 and C Mk3 – Aircraft Servicing Manual – Flight Control Systems Amendment 21 – dated July 1998.**

Reference 38. **AP101B 0701/03 – 1A Sect XIII para 13-11(1) to (4) inclusive Hercules C Mk1 and C Mk3 – Aircraft Servicing Manual – Ground Handling, Amendment 15 – dated December 1994.**

Reference 39. **AP101B-0701/02/03 – 5A2 Chap 1A, Card 35 para 20 (a) to (f) inclusive. Health and Safety Dangerous Engineering substances Hercules C1,W2 and C3 Amendment 15 dated March 1999.**

TriStar Aircraft

Reference 40. **AP101B-5100-5A2 Chap 4, Card 7, para 27/00 – TriStar All Marks Hazard Information – Caution Notes. Last amended 3 March 2000.**

Reference 41. **AP101B-5101-1U4, Chap 55-20-00, page 1, para1 – AMM Elevator Description and Operation. Last amended 19 December 2000.**

Reference 42. **AP101B-5101-1J2, Chap 27-31-04- AMM Depleted Uranium Elevator counterbalance weights – Removal and Installation. Last amended 9 December 1999.**

Reference 43. AP101B-5101-1J1, Chap 27-21-32 - AMM Rudder counterbalance weights – Removal and Installation. Last amended 12 January 2001.

31. All of the above publications are mandatory for tradesmen undertaking work on either Hercules or TriStar DU flight control systems counterbalance weights. The advice contained within these documents for the safe handling of DU is consistent with that detailed in JSP 392. Briefly summarised it states that tradesmen must wear protective clothing (including respiratory protection) when corroded counterbalance weights are being handled. Tradesmen are also instructed to wash thoroughly before eating, smoking or touching another individual.

32. Early versions of Wessex helicopters and Dominie aircraft also utilised DU counterbalance weights, but these are no longer part of the current fleet and will not be considered further. Specifically, all earlier marks of Wessex were fitted with DU rotor tip weights. However Modification 2023 introduced in 1981 removed these from all service operational and sustainment fleets: the replacement is a tungsten alloy. In light of the fact that Wessex declared surplus up to and including 1981 could have been made available for technical training aids and as gate guardians, MOD has advised both the Joint Services Disposals Committee and HMS SULTAN that DU may still be in-situ in the rotor blades of earlier aircraft.

Aircraft Accident Investigations

33. Military personnel involved with accident investigation or crash recovery have access to an Aircraft Hazard Database. This is locally produced, but is generated from inputs from aircraft project teams, operational users, the RAF Centre for Aviation Medicine, and DRPS. The database contains guidance on DU for both the Hercules and TriStar. It is circulated widely on CD ROM to regional RAF Post Crash Management Incident Officers and is primarily used for guidance by Aircraft Recovery Officers (ARO). The ARO is responsible for all Health and Safety matters within the working perimeter of all military crash sites. The advice given on the database is again consistent with that detailed above.

MOD Test, Evaluation and Training Ranges in the UK

34. The only range where DU ammunition is test fired at present is Kirkcudbright on the Solway Firth. There is also a range at Eskmeals in Cumbria that has facilities for DU firing, but these have not been used since 1995. DERA Eskmeals is approved to store up to 5 tonnes of DU and therefore has to have a Special Hazard Assessment carried out. This document is:

Reference 44. Special Hazard Assessment for the Use and Storage of DU at DERA Eskmeals, DRPS Report 20/99.

In addition, and in line with JSP 392 and ESTC guidance notes, there are local rules and contingency plans in place at Eskmeals to control access to the former firing sites. The battery itself is a declared Controlled Radiation/Contamination Area and is bounded by a wire fence. Entry is through a Health Physics Control Room, where protective clothing and personal dosimeters are issued. Personnel undergo checks for contamination when leaving the controlled area. These safety precautions are in line with JSP 392 and ESTC guidance notes and are supplemented by a series of contingency plans, systems of work, hazard assessments and evacuation procedures, which have been developed in conjunction with DRPS.

35. Occasional firing still takes place at Kirkcudbright. The areas surrounding one of three firing points and the target area are known to be contaminated and are treated as controlled contamination areas. A long term environmental monitoring programme on the effects of DU test firing has been in place at Kirkudbright since 1983, including an independent assessment by WS Atkins Ltd, published in 1995, that concluded that the firing programme had produced a negligible impact on the local environment. As with Eskmeals, local rules and contingency plans cover these areas. When these areas are in use, the applied safety precautions are in line with JSP 392 and ESTC guidance notes. Additional contingency plans and systems of work have been prepared with additional guidance from DRPS. The Local Rules and Contingency Plans for Eskmeals and Kirkcudbright are produced in a single consolidated document by the DERA Ranges Health Physics section at Eskmeals. It is:

Reference 45. DERA/RANGES(ESK)/HP/1/.0 dated August 1999.

Research Establishments

36. DERA also has a quantity of DU held at Fort Halstead for research purposes. Fort Halstead is authorised to hold up to 10 tonnes of DU. In line with JSP 392, it is therefore obliged to carry out a Special Hazard Assessment for its use. This document is referenced below:

Reference 46. Special Hazard Assessment for the Use and Storage of DU at DERA Fort Halstead DERA/DRPS/92/2000.

Additionally it has carried out a risk assessment which also covers the actions required to reduce these risks. The document is referenced below:

Reference 47. Risk Assessment for Operations Involving DU at Fort Halstead DERA/MSS/MSMA/RA003349.

Again, in line with instructions in JSP 392 and ESTC guidance notes, Fort Halstead has written schemes of work and local rules covering individual buildings which are used for DU work.

37. Finally, some quantities of raw and waste DU are held at AWE Aldermaston, AEA(T) Harwell and BNFL Springfield. These are subject to UK Statutory legislation and supplementary periodic checks by the MOD.

Conclusion

38. This paper shows that the MOD takes its responsibilities as an employer and user of DU seriously. Written instructions in compliance with government legislation are in place in all areas where servicemen, servicewomen and civilian staff regularly come into contact with DU. These instructions highlight the hazards, safety advice and contingency plans to be employed when DU is used. The written instructions are supplemented where necessary with advice from the DERA Radiation Protection Service and the safety guidance and protective equipment recommended reflects the degree of risk each task carries.

39. Preparing this paper has allowed MOD to review the extent, coverage and consistency of this advice. We are satisfied that there are no gaps concerning locations where DU is currently held by MOD. Nor are there gaps concerning the different types of activity by MOD (i.e. transportation, storage, firing, and research). We regularly review our health and safety procedures to ensure that they reflect our responsibilities to our employees and specific strands of further work include:

a. examining the rationale for the precautions recommended during aircraft maintenance, which may be overly cautious given the risks involved;

b. developing the procedures for the return of possibly contaminated barrels from operations;

c. developing the procedures for monitoring and disposing of contaminated tank gun barrels.

References

High Level MOD Guidance

1. Joint Service Publication 375, the MOD Health and Safety Handbook

2. Joint Service Publication 392 Instructions for Radiation Protection.

3. DRPS Fact Sheet No 15 – Depleted Uranium dated 1 August 2000.

4. DRPS Fact Sheet No 16 – Depleted Uranium Rounds dated December 1998.

5. Joint Service Publication 445 Transport of Dangerous Goods by Road, Rail and Sea.

6. Joint Service Publication 335 Dangerous Air Cargo Regulations

7. Joint Service Publication 471 Defence Nuclear Accident Response

8. Royal Air Force Nuclear Accident Response Organisation Manual 4th Edition AP110A-0103-1A1

Mid Level Guidance

9. ESTC Guidance Note 1 - Depleted Uranium Ammunition.

10. ESTC Guidance Note 5 - Contingency Planning for Accidents/Incidents involving DU Ammunition.

11. ESTC Prescription No 4 - covering DU Tank Ammunition.

12. ESTC Prescription No 5 - covering Phalanx Ammunition.

13. President's Letter 03/00 Safety Precautions for Operating with Depleted Uranium (DU) Tank Ammunition VP(P)/OB/B/6/7/2 dated 23 June 2000

14. LAND/CESO 7377 of 14 August 2000

Use, Storage and Transportation of DU Tank Rounds

15. TAB 6/2503 (C) (2nd Edit) –Shot 120mm Tank APFSDS with Depleted Uranium dated September 1999.

16. TAB AER/3097 (2nd Edit) – Special requirements on the storage and transportation of 120mm TK APFSDS ammunition containing Depleted Uranium dated August 2000.

17. TAB 21/3107 – Clearance of Armoured Fighting Vehicles.

18. TAB AER/3074 – Advice on the storage and transport of DU ammunition and the clearance of DU contaminated vehicles on operational deployments dated June 1999.

19. AER Vol 3 Pam 21 Part 3 Section 5 Annex H – EOD Procedure 8.

20. Kineton Station Standing Operating Procedure No 72, Radiation Safety dated September 2000.

21. Kineton Station Standing Operating Procedure No 73, Contingency Plans for Accidents Involving Ammunition containing Depleted Uranium dated September 2000.

22. Kineton Senior Ammunition Technical Officer Technical Instruction No 9, Handling Depleted Uranium Ammunition dated February 2000.

23. Defence Munitions Longtown Standing Orders Part 2.1.6, Annex A, Appendix 3 and Appendix 6. Orders for the Storage of Depleted Uranium ammunition and instructions for using Radiation Monitoring Equipment.

24. Special Hazard Assessment for the Use and Storage of Depleted Uranium at Kineton, DRPS Report 55/99.

25. Special Hazard Assessment for the use and storage of Depleted Uranium at Longtown, DRPS Report 56/99.

Use, Storage and Transportation of Phalanx 20mm Ammunition

26. BR8475(2C) Close in Weapons System Phalanx – CIWS(1) Block 1 &1A.

27. Certificate of Safety for Shipborne Munitions for 20mm Phalanx Ammunition dated September 1999.

28. Ship Standing Orders.

29. CINO Safety Statement No 1020 dated August 2000.

30. BR1029(15) Chapter 8 Section 2.

31. STO(N) Standing Orders.

32. BR 862 Vol 4 dated December 1998.

33. CINO SAFE 1180 dated May 1999. (Carriage of CHARM 3 DU tank ammunition at sea)

34. Defence Munitions Dean Hill Local Radiological Orders dated 20 March 2000.

35. Special Hazard Assessment for the Use and Storage of Depleted Uranium at Dean Hill, DRPS/MRG/21083/Dean/RM dated 24 January 2001.

36. Defence Munitions Gosport Health and Safety Procedure 014, Radiation Safety Orders dated January 2000.

Aircraft Maintenance and Accident Investigation

37. AP101B 0701/03 – 1G Sect VI para 6-19 (1) to (4) inclusive – Aircraft Servicing Manual – Flight Control Systems Amendment 21 – dated July 1998.

38. AP101B 0701/03 – 1A Sect XIII para 13-11(1) to (4) inclusive – Aircraft Servicing Manual – Ground Handling, Amendment 15 – dated December 1994.

39. AP101B-0701/02/03 – 5A2 Chap 1A, Card 35 para 20 (a) to (f) inclusive. Health and Safety Dangerous Engineering substances Hercules C1,W2 and C3 Amendment 15 dated March 1999.

40. AP101B-5100-5A2 Chap 4, Card 7, para 27/00 – Tri Star All Marks Hazard Information – Caution Notes. Amended 3 Mar 2000.

41. AP101B-5101-1U4, Chap 55-20-00, page 1, para1 – AMM Elevator Description and Operation. Last amended 19 December 2000.

42. AP101B-5101-1U4, Chap 55-40-00, page 1, para1 – AMM Rudder Description and Operation. Last amended 19 December 2000.

43. AP101B-5101-1J2, Chap 27-31-04- AMM Depleted Uranium Elevator counterbalance weights – Removal and Installation. Last amended 19 December 1999.

44. AP101B-5101-1J1, Chap 27-21-32 - AMM Rudder counterbalance weights – Removal and Installation. Last amended 12 January 2001.

Test, Evaluation and Training Ranges in the UK

45. Special Hazard Assessment for the Use and Storage of DU at DERA Eskmeals, DRPS Report 20/99

46. Local Rules and Contingency Plans for Eskmeals and Kirkcudbright. DERA/RANGES (ESK)/HP/1/1.0 dated August 1999.

Research Establishments

47. Special Hazard Assessment for the Use and Storage of DU at DERA Fort Halstead, DERA/CDB/DRPS 97/2000.

48 Risk Assessment for Operations Involving DU at Fort Halstead DERA/MSS/MSMA/RA003349.

Annex A

Relevant Government Legislation Covered by JSP 392

Legislation	Application
Health and Safety at Work 1974	Health and safety of people at work
Environmental Protection Act 1990 (as amended)	An enabling act covering environmental issues
Radioactive Material Act 1991	An enabling act covering transport of radioactive material
Radioactive Substances Act 1993	Use, keeping and disposal of radioactive material
Carriage of Dangerous Goods by Road Regulations 1996	Training Requirements for drivers of vehicles transporting radioactive materials
Radioactive Material Regulations (Road Transport) 1996	Transport of radioactive material by road
Ionising Radiation Regulations 1999	Radiation protection of persons against ionising radiation arising from any work activity
The Ionising Radiation (Protection of people undergoing medical examinations or treatment) Regulations 2000	Protection of people undergoing examinations or treatment involving the use of ionising radiations

Annex B

A Summary of the Safety Guidance and Procedures as Described in President's Letter 03/00 Safety Precautions for Operating with Depleted Uranium (DU) Tank Ammunition ,VP(P)/OB/B/6/7/2, dated 23 June 2000.

Introduction

- DU contains naturally occurring radioactive material. It is a low Specific Activity material and is as chemically toxic as lead.
- There are detectable radiation levels close to DU munitions but the radiation dose drops off quickly with distance and is down to very low levels by 2m. It is good practice to keep radiation doses down by reducing the time spent close to stocks of DU munitions.
- The radiation dose a person receives can be measured by wearing a thermoluminescent dosimeter.
- It is recommended that personal radiation dose records are maintained.
- A Radiation Protection Advisor should be appointed for a theatre where DU munitions are deployed. *(NB DRPS has been appointed as RPA for overseas operations)*

Hazards

- The main DU hazard is inhalation of particulate material formed during a fire or explosion or on impact or when DU is damaged. Anything which prevents particulate material being inhaled (eg wearing a respirator or dust mask) or redistributed (eg working in wet conditions) reduces the risk. All personnel should be warned of the possible hazards and risk reducing measures.
- Direct contact between DU and the skin should be avoided whenever possible. . Wearing gloves greatly reduces any risk.

Contaminated Areas

- Personnel should avoid inhaling the smoke from fires involving DU munitions
- Areas contaminated by DU Oxide dust should be avoided. Where they cannot personnel should wear gloves and respiratory protection. Where dust raising activities are carried out consideration should be given to wearing full IPE.
- Radiation monitoring equipment should be deployed and individuals trained in its use.
- Ingestion is less hazardous than inhalation. Hands should be washed as soon as possible.
- After work in a contaminated area is complete outer clothing should be stored in a plastic bag until laundering or disposal among non-radioactive waste.

Medical

- Anyone concerned over possible DU exposure should report to their MO
- To prevent DU entering the body through cuts, any open wounds should be covered with a waterproof dressing before entering a contaminated area. Cuts should be allowed to bleed and rinsed freely if thought to be contaminated. The cut should be covered with a dry dressing and reported to the Medical Officer.

Storage and Transport

- Radiation Protection Supervisors should be appointed by Commanding Officers. Local rules should be written to ensure risks are reduced to lowest possible levels and should include contingency plans for reasonably foreseeable accidents.
- Risk assessments must be carried out for all procedures involving DU.
- Everyone working on DU must be aware of local rules and contingency plans. Drivers must receive the training required by the DETR.

Royal Armoured Corps

- Crewmen and maintenance personnel are designated as Unclassified Radiation Workers.
- Personnel should wear gloves where-ever possible when handling DU rounds.

- DU stowed tanks are controlled radiation areas and TLDs should be issued.

Contaminated Tank Barrels

- It should be assumed that all guns which have fired DU munitions are contaminated until monitoring proves otherwise.
- All barrels that have fired DU munitions should be monitored.
- After first firing of DU munitions, gun documents should be amended to register the possibility of contamination

Cleaning Contaminated Barrels

- Potentially contaminated gun barrels should be wiped before maintenance.
- Cleaning materials should be disposed if as non radioactive waste.
- Skin contact should be avoided. Respiratory protection is not required if no abrasion if the barrel is likely.
- After work is completed individuals should wash their hands.

Transporting Contaminated Barrels

- Barrels should be cleaned thoroughly as described above before transport.
- Barrels that have not been monitored after firing DU must be transported as excepted packages.

Disposal of Barrels

- Barrels that might have fired DU should be monitored before disposal.

Range Controls

- Firing of DU for trials and training should be confined to nominated ranges.
- Contaminated sabots pose no significant radiological hazard.

Fire Fighting

- The alerting procedures described in local rules should be implemented
- Support forces should be advised of the DU hazard
- Personnel should avoid inhaling the smoke
- The fire should be quenched with copious quantities of water
- The location of potentially contaminated water courses should be recorded
- Halons should not be used for fighting DU fires
- Fire fighters and their equipment within the Inhabited Building Distance (IBD) should be monitored for contamination
- Medical staff should be advised that evacuated casualties may be contaminated.