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Bristol BS34 8JH
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ORDNANCE BOARD

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VP(P)/OB/B/6/7/2

OB Project G91/041

23 Jun 00

PRESIDENT'S LETTER 03/00
SAFETY PRECAUTIONS FOR OPERATING WITH DEPLETED URANIUM (DU) TANK AMMUNITION

References:

A. D/OB/4259/1 dated 9 Jan 91 (Member's Letter 03/91).
B. CINO 63CSAFE195 Issue No A dated 22 Mar 91.
C. DRPS Report 13/93 dated 28 Jul 93.
D. ESTC Guidance Notes No 1 1997 - Guidance Notes for the Storage and Transport of DU Munitions.
E. ESTC Guidance Note No 5 1996 - Contingency Planning for Accidents/Incidents Involving DU Ammunition.
F. ESTC Prescription No 4 1996.
G. CINO SAFE 1180 dated 13 May 99.
H. VP(P)/OB/B/6/7/3 dated 4 May 99 (Member's Letter 54/99).
J. DRPS 460/20/13525/DRPS dated 29 Feb 00.
K. DRPS 690/2/13940/DRPS dated 16 May 00.
L. DRPS 460/20/14173/DRPS dated 14 Jun 00.

INTRODUCTION

1. DDEC (DBE) and IPT Tk Sys Sp have requested advice on general safety precautions for operating with depleted uranium (DU) tank ammunition for inclusion in publications. Previous OB advice has covered the special precautions that are required for transporting, handling and firing DU ammunition, as well as the precautions for examining targets which have been hit with DU ammunition. This letter covers all relevant advice for the User on DU tank ammunition. It includes advice on barrel and sabot contamination, which were first reported in 1998 and subsequently confirmed by trials 1998-99.

2. Two DU rounds are currently in service with the British Army. Shot 120mm Tank Armour Piercing Fin Stabilised Discarding Sabot (APFSDS) L26A1 was developed under the CHARM 1 programme and can be fired from both the L11 gun in Challenger 1 (CR1) and the

L30 gun in CR2. It has a DU long rod shot core surrounded by an aluminium alloy sabot. Shot L26A1 are transported in the specially designed Ammunition Container Assemblies (ACA) L276A1 and L276A2.

3. Shot 120mm Tank APFSDS L27A1 was developed under the CHARM 3 programme and can only be fired from the L30 gun in CR2. It is of similar design to the L26 shot. Shot L27A1 are transported in the purpose built ACA L288A1 with the L16 charge, and in ACA L298A1 with the L17 charge.

AIM

4. The aim of this letter is to provide advice on safety precautions for operating with DU tank ammunition.

INFORMATION

PREVIOUS ADVICE

5. Initial advice on the L26A1 shot and L14 charge combination, known as the JERICHO round, was provided in Reference A for Operation Granby. The radiation hazard was summarised (para 7) as follows:

> "DU has a specific activity of generally not more than 45 MBq/kg for all emissions of which the alpha activity is generally taken as 25 MBq/kg."

The Member Most Concerned (MMC) remarked (para 23) as follows:

> "DU Hazards. Introduction of the CHARM shot brings DU ammunition into UK Army service for the first time. The radiation hazard to tank crew and during transportation has been judged to be acceptably low. On account of the pyrophoric nature of DU and the toxic, radioactive, heavy metal oxide dust that will result from burning on target strike, there will continue to be a need to restrict any firing training to specifically nominated sites. During service use precautions need to be taken against inhalation of the toxic dust which will be present in an ammunition fire or as a result of a target strike."

6. CINO published at Reference B the safety assessment for carriage by sea of L26A1 shot.

7. A full description, entitled "Radiological and Chemical Hazards of DU", was published by the Defence Radiological Protection Service (DRPS) in Reference C. Further advice on DU munitions may be found in ESTC Guidance Notes Nos 1 (Ref D) and Nos 5 (Ref E).

8. In OB Proc 42883 (14 Oct 93), the Board published advice on L26 shot in the L30 gun in CR2. The Board remarked on the potential radiation hazard posed by the L26's DU rod (para 42):

a. Where DU shot was fired, crewmen were to wear gloves when handling bare rounds.

b. It might be necessary to issue crewmen with dosimeters and to monitor their exposure levels.

c. During hostilities, where personnel might be required to enter an area contaminated by DU oxide dust caused by the destruction of an armoured vehicle or an ammunition fire, they should be instructed to wear a mask that provides particulate filtration, as a safeguard against inhalation of toxic dust.

d. It was necessary to restrict trials/training firing to nominated ranges.

9. ESTC Prescription No 4 (Ref F) publishes the storage and transport procedures for 120mm Tk APFSDS DU rounds under UK regulations and applies to both L26A1 and L27A1 shot with their associated charges.

10. In OB Proc 42988 (10 Jun 97) the Board reported on the CHARM 3 round. The Board made the following decisions and recommendations (para 65b) on the radiation hazards, based on advice from professional radiation advisers:

a. Exposure in Tank. When DU shot was stowed in the tank, it was to be declared a Controlled Radiation Area. Personnel working in a tank stowed with DU shot were to wear thermo-luminescent dosimeters (TLD). Service personnel were not, other than on operations, to be in a tank fully stowed with DU shot for more than 80x24 h days in one year.

b. Exposure to Residues from Target Strike or Ammunition Fires. Service personnel were to be advised not to enter DU struck targets, before they had been assessed for freedom from DU oxide dust, without taking due respiratory and contamination precautions. The ESTC advice in Prescription No 4 (Ref F) was to be followed in the case of ammunition fires involving DU.

11. CINO published at Reference G the safety assessment for carriage by sea of CHARM 3 Ammunition (L27A1 shot and L16A1 charge).

12. In Reference H, the MMC advised that Shot, 120mm Tank, APFSDS, L26A1 with Charges Propelling L14A1 and L14A2 transported in Unit Load Container (ULC) ACA L276A2 was safe and suitable for service on operations in 1999. Further evidence was required from qualification trials on the charges before the round could be cleared beyond 1999.

PRESIDENT'S REMARKS

13. The safety precautions detailed at Annex A are drawn from previous advice where relevant and from more recent advice by DRPS at References J, K and L. These precautions supersede previous advice given and may be taken as a comprehensive summary of extant advice. This advice should be incorporated into the Product Approval Certificates for CR1 and CR2 and further disseminated through AESPs and training publications.

14. Further work is recommended in a number of areas, as detailed in Annex A. A summary of recommendations from Annex A is below:

a. MOD/HQ LAND should appoint a Radiation Protection Adviser (RPA) for a theatre where DU munitions are deployed (Annex A serial 5).

b. The Army should be trained in the hazards of DU and in procedures for operating in a theatre where DU munitions are present. All troops in theatre require briefing since the main hazard from DU is the inhalation of the particulate material formed during a fire or explosion involving DU munitions, or when a DU round impacts on a hard surface. Particulate material will also be produced when tank armour containing DU is damaged (Annex A serials 7 and 9).

c. When DU rounds are deployed, TLDs should be issued to tank crews and to REME personnel regularly working in tank turrets (Annex A serial 33 and Annex B para 51c).

d. IPT Tk Sys Sp should arrange for CR1 barrels which fired L26 shot on Operation Granby to be monitored by DRPS (Annex A serial 36).

e. IPT Tk Sys Sp should publish in AESPs a procedure for transporting DU contaminated barrels as "Excepted Packages" (Annex A serial 44).

f. IPT Tk Sys Sp should dispose of contaminated barrels, as advised by DRPS (Annex A serials 46-47).

g. IPT Tk Sys Sp should develop a procedure with DRPS for measuring contaminated sabots (Annex A serial 52).

h. Ranges should dispose of contaminated sabots, with advice from DRPS and IPT Tk Sys Sp (Annex A serial 53).

15. The DU hazard needs to be formally reassessed as a result of the revision of the Ionising Radiations Regulations in 1999 (IRR 99). It has not yet been decided whether MOD will apply a 20mSv per year dose limit, or make use of a provision that allows an individual to receive a radiation dose of 50mSv in one year if the cumulative exposure over a 5 year period does not exceed 100mSv. This is a policy issue that will need to be staffed through D SEF Pol by IPT Tk Sys Sp. DRPS favour the latter option as this provides a degree of flexibility for operational commitments (Ref J para 3).

16. Since publication of OB Proc 42988, the CHARM 3 Reporting Proceeding, IRR 99 have replaced IRR 85. OB Proc 42988 therefore requires amendment. Amendment 1 is at Annex B.

PRESIDENT'S ADVICE

17. As President of the Board, I advise that the safety precautions in this letter should be adopted by all personnel in contact with DU tank ammunition or its residue.

18. I draw attention to my Remarks.

[redacted]
President, Ordnance Board

Annexes:

A. Safety Precautions.
B. Amendment 1 to OB Proc 42988.

Distribution:

External:

Action:

ES(Land) IPTL Tk Sys Sp
DBE RM IPT Tk Sys Sp
ES(Land) IPT Tk Sys Sp 4
ES(Land) IPT Tk Sys Sp 4a
ES(Land) IPT Tk Sys Sp 4f (ILS)
HQ LAND COS
HQ LAND, CESO(A) (Airfield Camp, Netheravon)
HQ DRAC SO2 CR2
DERA Eskmeals
Kirkcudbright Range Manager

Information:

CM Manoeuvre
DEC(DBE)
DDEC (DBE)
AD DGM IPT
DGM IPT Heavy Munitions
D SEF Pol
Sec ESTC
CINO
ATDU
DERA WS4
DRPS
DRIC

Internal:

OSG GL and VP(OB)
Member A/N
Member B
Member E
Member G
Member S
R Division
Bd
Sn4
OSG BS1b
VP(P)/OB/B/1/12
Library

Consignors Certificate for Radioactive Material

MOD Form 663
Revised 9/96
PPQ = 50

Read the Notes overleaf before completing this form

1. Delivery To (Consignees Name and Address)

☎

2. Description (including proper shipping name and UN number)

Radioactive material, excepted package
– limited quantity of material
UN No 2910
UN Class No. 7

3. Radioactive Material / **4. Packages**

Radionuclide	Form		Activity Bq	Number of Packages	Label Category	Transport Index	Type
Name or Symbol of each or principal nuclide	Special Form or Surface Contaminated Object (SCO I or III) or Low Specific Activity (LSA I, II or III)	Chemical Form and Physical State (Gas/Liquid/Solid)	As measured		I White Or II Yellow or III Yellow	For Yellow Label Categories only	Industrial Package (IP 1, 2 or 3) Type A Type B(U) or B(M) Special Arrangement
DU	Other form	Solid			N/A	-	Excepted

Exclusive Use Shipment (tick box) Yes ☐ No ☐

5. Excepted Packages (tick box)
Is package an excepted package? ☐ No ☐

6. Fissile Material (tick box)
Is Material Fissile? Yes ☐ No ☐
Is Material Fissile Excepted? Yes ☐ No ☐
Mass of Fissile Material
(required only if activity not entered in 3.)

7. Competent Authority Approval (Reference IAEA Safety Series 6 Section VII)

a. Subject to Competent Authority approval of carriage Yes ☐ No ☐
b. Competent Authority package identification marks
c. Special form certificate no(s) dated
d. Package design certificate no(s) dated
e. Shipment certificate no(s) dated
(where different from package design no)

8. Nuclear Matter (see notes 3 and 4) (tick box)

Is matter nuclear matter? Yes ☐ No ☐
Is material excepted Yes ☐ No ☐
Indemnity Certificate Reference dated
(only for transport outside of the UK)

9. Consignor (Address at which consignor can be informed in case of an accident)

☞

10. Special Handling Information
Enter special handling information on reverse of form

11. Declaration
This is to certify that the above-named goods are properly described and are packed and marked in accordance with the applicable provisions of the

Signature of Consignor **Date**

Name and Title of person signing on behalf of the Consignor

Notes to be read before completing this form

1. A copy of this form is to be completed for all consignments of radioactive material (including radioactive waste) and included with the transport documents.

2. This form is to be used together with the international regulations IAEA Safety Series no 6 Regulations for the Safe Transport of Radioactive Material 1985 Edition (as amended 1990). (See also information below).

3. Nuclear matter which is not excepted matter consigned from a site is subject to certain provisions of the Nuclear Installations Act 1965, including:

a. a statutory duty of care.
b. funds to be available to meet claims up to prescribed limits.
c. a certificate to the effect of b. above for carriage outside the UK.

4. For definition of nuclear matter and excepted matter see the Nuclear Installations Act 1965 Section 26 as amplified by SI 1978 No. 1779 Nuclear Installation (Excepted Matter) Regulations 1978, and as amended by the Energy Act, 1983. It should be noted that **Radioactive Waste** is excluded from the definition of excepted matter.

5. For further information and sources of advice see JSP 392 Ch.26

6. This form complies with the Radioactive Material (Road Transport)(Great Britain) Regulations 1996.

7. For road transport, one completed and signed copy must be handed to the Carrier (or where the Carrier is also the Consignor, to the driver of the Vehicle).

8. One form is to be completed for each freight container or overpackage, if used.

IAEA Safety Standards; Safety Series No.6

Regulations for the Safe transport of Radioactive Material; 1985 Edition (As amended 1990)

Proper Shipping Names	-	Appendix 1, Page 95
UN Numbers	-	Appendix 1, Page 95
Surface Contaminated Object	-	Para 144 Page 9
Low Specific Activity Material	-	Para 131 Page 5
Label Category	-	Para 435, Page 43
Transport Index	-	Paras 428 -430, pages 40 - 41.

Excerpt from List of United Nations Numbers, Proper Shipping Name and Description

Number	Name and Description
2910	Radioactive Material, Excepted Package - Instruments or Articles - Limited Quantity of Radioactive Material - Articles Manufactured from Natural Uranium or Depleted Uranium or Natural Thorium - Empty Packaging
2912	Radioactive Material, Low Specific Activity (LSA), not otherwise specified.
2913	Radioactive Material, Surface Contaminated Object (SCO)
2914	Radioactive Material, Fissile, Not otherwise Specified
2974	Radioactive Material, Special Form, not otherwise specified
2982	Radioactive Material, Not otherwise Specified

10. SPECIAL HANDLING INFORMATION

There are/may be traces of depleted uranium within this barrel.
The barrel must be sealed at both ends to comply with transport regulations.

ANNEX A TO
VP(OB)/OB/B/6/7/2
DATED 23 JUN 00

SAFETY PRECAUTIONS FOR OPERATING WITH DEPLETED URANIUM (DU) TANK AMMUNITION

Prepared by B Division, Ordnance Safety Group (OSG)

References:

A. DRPS 460/20/13525/DRPS dated 29 Feb 00.
B. DRPS 460/20/14173/DRPS dated 14 Jun 00.
C. D/SEF Pol/2/6/4 dated 23 Feb 00.
D. DPPS 690/1/13437/DRPS dated 21 May 99.
E. DRPS 690/2/13940/DRPS dated 16 May 00.
F. DERA KT/2056/98 dated 19 Feb 99.
G. DERA KT/2053/98 dated 8 Dec 98.
H. ESTC Prescription No 4 1996.

Ser	Advice	Source
(a)	(b)	(c)
1.	INTRODUCTION	
2.	DU contains naturally occurring radioactive material and is known as a Low Specific Activity material. It is also chemically toxic to about the same extent as lead.	Reference A Enclosure 1 para 3
3.	There are detectable radiation levels close to DU munitions, but the radiation dose rate drops off quickly with increasing	Reference A Enclosure 1

Ser	Advice	Source
	distance and is down to very low levels at 2 m. It is good practice to keep radiation doses down by reducing the time spent close to stocks of DU munitions. The radiation dose that a person receives can be measured by wearing a thermoluminescent dosimeter (TLD), but this will only be necessary for those who could spend hundreds of hours per year close to DU munitions.	para 15
4.	It is recommended that personal radiation dose records are maintained for medico-legal purposes, even when there is no statutory requirement for such dose recording. This is a prudent precaution in the light of ongoing concerns over the possible health hazards from DU munitions.	Reference A para 9
5.	A Radiation Protection Adviser (RPA) should be appointed for a theatre where DU munitions are deployed. MOD/HQ LAND should be responsible for staffing the appointment of RPAs. DRPS have suitably qualified personnel, and can provide radiation monitoring equipment.	OSG
6.	<u>HAZARDS</u>	
7.	The main hazard from DU is the inhalation of the particulate material formed during a fire or explosion involving DU munitions or when a DU round impacts on a hard surface. Particulate material will also be produced when tank armour containing DU is damaged. Some particulate is likely to be produced in all impacts, but the amount of particulate increases as the "hardness" of the target increases. Anything which prevents particulate material being inhaled (such as wearing a respirator or dust mask) or redistributed (such as working in wet conditions, covering the contamination with a tarpaulin or sealing the contamination in place with paint) reduces the risk.	Reference A Enclosure 1 para 8
8.	The potential hazards from DU munitions are only likely to give rise to long-term health problems and priority must always be given to reducing or eliminating other hazards that produce severe and immediate health effects. The deployment of DU munitions should not be delayed on radiation safety grounds if an assessment of the threat to UK troops indicates a need for its use. Although the use of DU during in theatre training may not be desirable, there are no compelling reasons why it should be discouraged if there are demonstrable operational benefits. An important consideration is that remediation can be carried out at a later date if records are kept of areas where DU munitions are used. Restriction of access to contaminated areas will also provide a high degree of protection against any possible DU hazards.	Reference A para 2 & 14
9.	All personnel should be warned of the possible hazards from DU and of the measures that will reduce any risks to the lowest practicable levels.	Reference A Enclosure 1 para 1

Ser	Advice	Source
10.	Direct contact between DU and bare skin should be avoided whenever possible. Increasing time of exposure gives increasing risk. The wearing of gloves greatly reduces the risks.	Reference A Enclosure 1 para 14
11.	<u>CONTAMINATED AREAS</u>	
12.	Bearing in mind explosives safety considerations, personnel should attempt to stay upwind of any fires involving DU munitions and avoid inhaling the smoke.	Reference A Enclosure 1 para 18
13.	The hazard increases as the amount of DU increases and fires in ammunition stores present greater risks than fires in tanks.	Reference A Enclosure 1 para 11
14.	DU fragments often have very sharp edges and may cause injury or damage protective clothing.	Reference A Enclosure 1 para 7
15.	The hazard from any contaminant decreases with increasing distance from the source and therefore the greatest risk from DU will be close to the seat of a fire or within a few tens of metres of the point where DU impacts on a hard target.	Reference A Enclosure 1 para 12
16.	Where possible, areas contaminated by DU oxide dust caused by the destruction of an armoured vehicle, or an ammunition fire, should be avoided. Where personnel are required to work within 50 m of such an area, they should wear gloves and a mask that provides particulate filtration, such as a dust mask or service respirator. Where dust-raising activities are carried out, consideration should be given to wearing full NBC Individual Protective Equipment (IPE).	Reference A Enclosure 1 paras 6 and Reference B para 2
17.	Radiation monitoring equipment should be deployed following advice from the Radiation Protection Adviser (RPA). Individuals should be trained in the use of this equipment by the RPA.	Reference A Enclosure 1 para 16 & OSG
18.	Ingestion of DU is a hazard. Ingestion is less hazardous than inhalation. Good personal hygiene measures will help reduce any risk of ingestion to the lowest practicable level. Hands should be washed as soon as possible after working in any area where DU contamination may be present. Hands must always be washed before eating, drinking or smoking.	Reference A Enclosure 1 para 9
19.	After working in an area where DU may be present, personnel should brush down their outer clothing before removing their gloves and mask. Where possible, the outer clothing should then be removed and stored in a plastic bag until it can be laundered.	Reference A Enclosure 1 para 13 and Reference B para 2

Ser	Advice	Source
	When NBC IPE has been worn, and replacement filters and suits are not available, they should be retained for use against any perceived NBC threat. Filters and suits should be disposed of by placing them in polythene bags and dispersing them among non-radioactive waste.	
20.	MEDICAL	
21.	Anyone concerned over possible DU exposure should report the fact to their Medical Officer.	Reference A Enclosure 1 para 19
22.	To prevent DU entering the body through cuts, any open wounds should be covered with a waterproof dressing before entering potentially contaminated areas. Cuts should be allowed to bleed freely and rinsed under running water if it is believed they might be contaminated with DU. The cut should then be covered with a dry dressing and the Medical Officer notified of the incident.	Reference A Enclosure 1 paras 10 and 17
23.	STORAGE AND TRANSPORT OF DU MUNITIONS.	
24.	Specially trained personnel known as Radiation Protection Supervisors will be appointed to supervise work with DU munitions and special work procedures known as local rules will be written to ensure radiation risks are reduced to the lowest possible levels. Local rules should contain contingency plans for dealing with any reasonably foreseeable accidents.	Reference A Enclosure 1 para 20
25.	Risk assessments must be carried out for all processes in which DU munitions are involved. This includes storage and transport. The RPA will assist with these assessments.	Reference A Enclosure 1 para 21
26.	DU ammunition can only be stored or transported in the authorised ACA when it is not stored or transported in a tank.	Reference C
27.	Everyone working with DU munitions or who might be affected by an accident involving DU munitions must be aware of the contents of the local rules and any actions required by the contingency plans. Drivers of vehicles carrying DU munitions must receive the training required by the Department of the Environment, Transport and Regions (DETR).	Reference A Enclosure 1 para 22
28.	Personnel should wear gloves whenever possible when handling DU rounds.	Reference A Enclosure 1 para 23
29.	Report accidents involving DU munitions to the RPA as soon as possible.	Reference A Enclosure 1

Ser	Advice	Source
		para 24
30.	ROYAL ARMOURED CORPS	
31.	CR2 crewmen including maintenance personnel who come into contact with DU ammunition are designated as Unclassified Radiation Workers when DU ammunition is deployed. It would take 85 x 24 hours days exposure to reach the 6mSv calender year dose that would require crewmen to be designated as Classified Persons.	Reference A para 18
32.	Whenever possible, personnel should wear gloves when handling DU rounds. Any glove including service issue gloves are suitable. When loading the gun, it is not practical to wear gloves, and so the loader should avoid touching the DU rod, by handling the shot on the sabot and combustible case.	OSG
33.	When DU rounds are deployed, TLDs should be issued to tank crews and to REME personnel regularly working in tank turrets. TLDs respond to low levels of radiation, and are not the same as the NBC lockets, which are designed to register the very high radiation doses that may be encountered during a nuclear conflict. TLDs can be ordered from DRPS's Dosimetry Section, who currently hold sufficient stocks for initial deployments. It is recommended that they are returned to DRPS for reading every 3 months (the maximum permissible wear period). The Dosimetry Section can be requested to keep the dose results on the HSE approved dose record keeping system.	Reference D
34.	CONTAMINATED TANK GUN BARRELS Introduction	
35.	Personnel should be aware that low levels of DU contamination may be present in gun barrels and fume extractors after DU munitions have been fired. It should be assumed that all guns, which have fired DU ammunition, are contaminated until they have been measured with a suitable monitoring instrument. Contamination may be both fixed and loose. Loose contamination is removable by non abrasive cleaning, after which fixed contamination remains.	Reference A Enclosure 1 para 26 & OSG
36.	All barrels that have fired DU munitions should be monitored. CR1 barrels have not yet been monitored for DU contamination. CR1 barrels which fired L26 shot on Op GRANBY should therefore be monitored. It is recommended that IPT Tk Sys Sp contract DRPS to carry out the monitoring, using DRPS equipment.	OSG
37.	After the first firing of DU munitions in a barrel, the following statement should be inserted in the gun documents.	Reference E para 5

Ser	Advice	Source
	"There may be traces of depleted uranium within this barrel. This does not present a significant risk if wet non-abrasive cleaning techniques are used, and hands are washed after work on the bore or fume extractor. Precautions must be taken to prevent inhalation of dust during work that might abrade the bore."	
38.	Cleaning Contaminated Gun Barrels	
39.	Non abrasive techniques should be used for cleaning potentially contaminated gun barrels. Barrels and fume extractors should be wiped clean with a damp or oily cloth before maintenance work is undertaken. This will minimise any possible release of dust. Barrel brushes and bore staves should be wiped clean after use. The cleaning materials should be disposed of by placing them in polythene bags and dispersing them among non-radioactive waste.	Reference A Enclosure 1 para 29 & Reference F para 13c
40.	Skin contact should be avoided when working on gun barrels and fume extractors that may be contaminated. Provided that no abrasion of the bore occurs, normal issue clothing is appropriate. Gloves should be worn. Any glove including service issue gloves are appropriate. Neither respirators nor face masks are required. No special precautions are required for changing, cleaning or disposing of clothing.	Reference A Enclosure 1 para 27 & OSG
41.	After working on gun barrels or fume extractors that may be contaminated, no eating drinking or smoking should be allowed until personnel have thoroughly washed their hands.	Reference A Enclosure 1 para 28
42.	Transporting Contaminated Gun Barrels	
43.	Before transporting contaminated gun barrels along the public highway, the bore should be cleaned thoroughly (using non abrasive techniques) to remove all traces of loose DU contamination. It should then be transported as an "excepted package" (unless the barrel has been monitored by DRPS and no contamination has been detected).	Reference A Enclosure 1 para 30 & OSG.
44.	Guidance on transporting DU contaminated barrels as "excepted packages" is at Appendix 1. IPT Tk Sys Sp should finalise the procedure with DRPS, for inclusion in AESPs.	Reference A Annex A
45.	Disposal of Contaminated Gun Barrels	
46.	At the end of their useful lives, contaminated barrels and fume extractors should be thoroughly cleaned (using non abrasive techniques) and monitored for residual DU contamination. It is recommended that IPT Tk Sys Sp contract	Reference A Enclosure 1 para 31

Ser	Advice	Source
	DRPS to carry out the monitoring, using DRPS equipment.	
47.	It is recommended that IPT Tk Sys Sp manage the disposal of contaminated barrels. Three disposal options have been proposed by DRPS (Ref D para 7).	Reference E para 7 & OSG
48.	RANGE CONTROLS	
49.	In trials and training, firing of DU ammunition should be confined to nominated ranges.	OSG
50.	Sabot Petals.	
51.	Low levels of DU contamination have been detected on some sabot petals after firing. Contaminated sabots pose no significant radiological hazard to persons coming into contact with them.	Reference G para 13d
52.	The measurement of DU contamination on petals is technically difficult because of their irregular shape and some experimental work is needed to develop a measurement procedure traceable to UK national standards. Preliminary indications are that this issue is of more relevance to environmental protection than personal safety. The experimental work should be managed by IPT Tk Sys Sp.	Reference D para 8 & OSG
53.	In peacetime, DU is only fired on special ranges. Where possible, potentially contaminated sabots should be removed from ranges, and measured for contamination. Disposal of contaminated petals should be managed by the range, using advice from DRPS and IPT Tk Sys Sp.	Reference E para 8 & OSG
54.	On operations, the collection of contaminated petals is of little relevance to battlefield clearance, as far greater benefits could be achieved by collecting DU fragments than contaminated petals.	Reference E para 8
55.	FIRE FIGHTING	
56.	The alerting procedures described in the local rules should be followed and non-essential personnel evacuated from an area of at least the radius of the relevant Inhabited Building Distance.	Reference A Enclosure 1 para 33
57.	Support forces should be advised of the possible DU hazard.	Reference A Enclosure 1 para 34
58.	Explosives safety precautions should be observed. This may involve the fire crew sheltering behind protective barriers.	Reference A Enclosure 1 para 35

Ser	Advice	Source
59.	Personnel should avoid inhaling the smoke which may be contaminated with DU and should stay upwind if possible. Self-contained breathing apparatus and gloves should be worn within the Inhabited Building Distance.	Reference A Enclosure 1 para 36
60.	The fire should be drenched with copious quantities of water delivered from a safe distance with the aim of rapidly cooling the combustibles. Excess water should be allowed to drain freely to sewers, storm drains or water courses.	Reference A Enclosure 1 para 38
61.	Halons (ie chemical fire suppressants) should not be used for fighting DU fires.	Reference A Enclosure 1 para 37
62.	After the fire is completely extinguished, the remaining ashes and debris should be thoroughly saturated with water.	Reference A Enclosure 1 para 39
63.	The location of any drainage points or watercourses that may have been contaminated should be recorded.	Reference A Enclosure 1 para 40
64.	Fire fighters, their equipment and anyone within the Inhabited Building Distance should be checked for DU contamination before they leave the accident site.	Reference A Enclosure 1 para 41
65.	Casualties should be evacuated to hospital and medical staff advised that they may be contaminated with DU.	Reference A Enclosure 1 para 42
66.	Clean-up should not commence until specialist support arrives. Advice on cleaning up after the accident, including the removal of contaminated equipment, should be obtained from the RPA.	Reference A Enclosure 1 para 43
67.	ESTC Prescription No 4 (paras 1.7 - 1.9) provides further details of action in the event of a fire or accident involving DU ammunition. In the event of an accident resulting in damage to the protective coating of the penetrator, it must be assumed that release of DU particulate may have occurred, for example by abrasion.	Reference H paras 1.7 - 1.9

Appendix:

1. Transportation of DU Contaminated Gun Barrels in Excepted Packages.

APPENDIX 1 TO
ANNEX A TO
VP(P)/OB/B/6/7/2
DATED 23 JUN 00

TRANSPORTATION OF DU CONTAMINATED GUN BARRELS IN EXCEPTED PACKAGES

References:

A. DRPS 690/2/13940/DRPS dated 16 May 00 Annex A.
B. DRPS 460/20/14173/DRPS dated 14 Jun 00.

The following guidance is extracted from References A and B.

1. There is no limit to the amount of DU that can be transported at any one time.

2. The DU must be totally enclosed within the package.

Comment by DRPS. There must be some means of sealing or covering the ends of gun barrels.

Comment by Ordnance Safety Group (OSG). The muzzle should be sealed with a cap and cover. The breech should be closed.

3. The package must be in good condition (ie intact) and legibly and durably marked with its permissible gross mass.

Comment by DRPS. One option might be for the mass to be stamped on each barrel at manufacture and stencilled onto existing barrels.

4. The maximum radiation dose rate at any point on the external surfaces of the package must not exceed 5μSv/h.

Comment by DRPS. It is impossible to conceive of any occasion on which this condition would not be satisfied.

Comment by OSG. This has been included for completeness. Monitoring will not be required.

5. Levels of loose contamination on the external surfaces of the package must not exceed 0.4Bq/cm² when averaged over any area of 300cm^2. (Although it would be preferable for loose contamination to be removed from the bore, this contamination will not present any significant risks during transport as the ends of the barrels are to be sealed. Some contamination of internal surfaces is permitted under both international and UK transport regulations.)

> Comment by DRPS. Monitoring will be needed to prove that this is the case and a procedure will need to be established (and justified) if less than 100% monitoring is to be carried out. This requirement may be met by smearing selected areas of the vehicle and sending this smear to DRPS for analysis.
>
> Comment by OSG. Both internal and external surfaces of barrels should be smeared at the conclusion of DU firing (ie at the end of an operation) before they are moved on public roads under peacetime restrictions. There is currently no evidence of external contamination. IPT Tk Sys Sp should establish further details of the procedure and equipment from DRPS, for inclusion in AESPs.

6. An inner surface of the package must be marked with a radiation warning sign that will be visible when the package is opened. Warning labels are not attached to the external surfaces of excepted packages.

> Comment by DRPS. The most practicable option would appear to be for muzzle caps used for sealing gun barrels to contain an appropriate warning on the inner surface. This should make clear that it is the interior of the barrel rather than the cap that is contaminated.

7. Drivers of vehicles used for transporting excepted packages must receive appropriate training.

> Comment by DRPS. The nature and content of the training should reflect the very low risk from these items.

8. Before the consignment is despatched, the consignor must contact the consignee and confirm that he is prepared to accept the consignment.

9. A Consignor's Certificate (MOD Form 663) should be raised. An example of a completed MOD Form 663 is at Enclosure 1.

> Comment by DRPS. It might be useful to consider whether the gun documents could function as a Consignor's Certificate if they were amended to include a Consignor’s declaration of compliance.

10. Copies of the Consignor's Certificate should be kept readily available in case problems arise during transport of the radioactive material.

Enclosure 1: Example MOD Form 663.

ANNEX B TO
VP(P)/OB/B/6/7/2
DATED 23 JUN 00

AMENDMENT 1 TO OB PROC 42988 CHARM 3 REPORTING PROCEEDING DATED 10 JUN 97

References:

A. DRPS 460/20/13525/DRPS dated 29 Feb 00.
B. DRPS 460/20/14173/DRPS dated 14 Jun 00.

1. Below is an extract of relevant paragraphs on DU safety from OB Proc 42988. These have been amended to take account of the Ionising Radiations Regulations 1999. The advice was received from DRPS at Reference A paragraphs 18-22 and Reference B paragraphs 11-12.

INFORMATION

INTEGRATION IN THE TANK

51. Radiation in Tank. The Radiation in Tank Trial (Ref 31) showed that, with a full stowed load of CHARM 3 shot, the maximum Effective Dose Equivalent was 0.94 mSv over 329 h to the anthropomorphic phantom in the Loader's crew station. DERA/DRPS made the following recommendations:

a. The interior of the vehicle be designated a Controlled Radiation Area when stowed with shot containing DU.

b. CR2 tank crews are designated Unclassified Radiation Workers during non-operational deployment of L27 shot. It is assessed that it would take 85 x 24 h days full time occupation of a fully stowed tank to reach the 6 mSv calendar year dose level that would require crewmen to be designated Classified Persons.

c. Whole body dosimetry, Thermoluminescent Dosimeters (TLD), should be issued to tank crews operating in vehicles stowed with DU shot. TLD when issued may be worn on the chest or waist as preferred by the crewmen. If for operational reasons TLDs are not available, a dose assessment is to be made, using the formula below in subparagraph 'e'.

d. It is recommended that individuals occupy vehicles loaded with DU shot for less than 80 days per year.

e. During operational deployment with CHARM 3 shot a dose assessment of each crew member should be made using the following formula:

$$D_{(EST)}(\mu Sv) = 70 \times N$$

(Where N = Number of 24 h days and D is estimated Dose)

52. ACA Radiation. The fully stowed ACA was monitored for radiation emissions. It was shown to meet the "excepted" package requirement (Ref 32) provided there is a metal plate on the base of the wooden pallet to prevent access to the inner base. Without that plate the ACA becomes an Industrial Package Type 1, and the DU must be moved as a Low Specific Activity (LSA) Class 1 item.

53. DU Dust. There is a danger from DU dust, a toxic and slightly radioactive heavy metal oxide, which will be present after an ammunition fire involving DU, or as a result of a DU target strike after firing. This is the same for CHARM 3 as reported for CHARM 1 in Proc 42883.

DECISIONS AND RECOMMENDATIONS OF THE BOARD

65. The Board consider that the 120 mm Tk APFSDS CHARM 3 round, Shot L27A1 with Propelling Charge L16A1, is safe and suitable for service use, in Climatic Categories A3/B1, C0 and C1, to be fired using TVE L4A2 in Gun 120 mm Tk L30 mounted in Challenger 2 tank with the following limitations and provisos:

b. Radiation and Contamination Hazards.

(1) Exposure in Tank. When DU shot is stowed in the tank, it should be declared a Controlled Radiation Area. Personnel working in a tank stowed with DU shot are to wear TLD. Service personnel shall not, other than on operations, be in a tank fully stowed with DU shot for more than 80x24 h days in 1 yr.

(2) Exposure to Residues from Target Strike or Ammunition Fires. Service personnel are to be advised not to enter DU struck targets, before they have been assessed for freedom from DU oxide dust, without taking due respiratory and contamination precautions. ESTC advice in Prescription Number 4 is to be followed in the case of ammunition fires involving DU.

References:

31. DERA PLSD DRPS Report 16/96 dated 16 Apr 96.
32. DRPS Report 5/96 dated 19 Mar 96.
34. DRPS 460/20/13525/DRPS dated 29 Feb 00.
35. DRPS 460/20/14173/DRPS dated 14 Jun 00.