DEPARTMENT OF THE NAVY
NAVAL SEA SYSTEMS COMMAND
WASHINGTON, D.C. 20362

IN REPLY REFER TO
SEA-6422F/PWF
8000
SER 72
SEP 10 1980

From: Commander, Naval Sea Systems Command
To: Nuclear Regulatory Commission
License Management Branch
Washington, D.C. 20555
Attn: Mr. Paul Guinn
Via: Naval Energy and Environmental Support Activity
Port Hueneme, CA 93043
Attn: Mr. Morris Code 43

Subj: U.S. Nuclear Regulatory Commission Source Material License, request for

Ref: (a) United States Atomic Energy Commission Source Material License No. SUB-1190
(b) NAVSEA ltr PMS 404-30FN:8402.62 Ser No. 894 dtd 15 February 1979
(c) NRC ltr FCLM:NB(12400) dtd 18 April 1979
(d) NAVNUPWRU ltr 43:WJM:gc 3256 Ser 1095 dtd 9 October 1979 (NOTAL)

Encl: (1) Control and Accountability of Depleted Uranium Ammunition
(2) Transportation of Depleted Uranium Ammunition
(3) NAVSEA Weapon Specification (NAVSEAWS) 10765B dtd 13 OCT 1979
(4) Effects of Depleted Uranium Ammunition on the Environment

1. Reference (a) is the current source Material License held by the Naval Sea Systems Command for the Close-In Weapon System (CIWS), Phalanx Ammunition, containing Depleted Uranium (DU) penetrators. The NAVSEA request for renewal of reference (a) was submitted by reference (b). The NRC response, reference (c) contained the subject license and requested additional information so that an operational and developmental license could be issued.

2. The following information is provided with respect to the possession of DU:

a. The total quantity of DU that the Navy will possess at any one time is 802,034 pounds (lbs) or 363,563 kilograms (kgs).

b. The location of the Naval Ammunition Depots and storage facilities at which the DU will be stored are listed in enclosure (1).

c. The specific procedures and instructions for storage at shore facilities are discussed in enclosures (1) and (2).

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d. DU Testing will be conducted at:

(1) Naval Surface Weapon Center
Dahlgren Laboratory
Dahlgren, VA 22448

(2) Naval Weapons Center
China Lake, CA 93555

(3) Naval Air Station
Point Mugu, CA 93042

(4) Pacific Missile Test Center
San Nicolas, Island
Point Mugu, CA 93042

(5) Naval Weapons Station
Concord, CA 94520

Tests will be conducted in accordance with enclosures (3). The specified tests include chemical, physical and ballistic evaluations.

e. The environmental impact of penetrator expenditures in normal operations as well as under circumstances associated with unintentional expenditure are discussed in enclosure (4).

f. NAVSEA Code 62YD, the CIWS Program Management Office, is responsible for the DU Ammunition Program. Specifically, the individuals responsible for the DU Ammunition testing are:

(1) CDR G.F. Monell, Jr. NAVSEA 62YD - Program Manager
(2) Mr. D. McCrae - Ammunition Manager
(3) Mr. P. Adams - Test Activity NSWC/Dahlgren Research and Development Engineer Code:G-35

A change from limited DU ammunition production to full scale production will begin in late 1981 and at that time, the ammunition program will be transferred to the Ammunition System Group, NAVSEA Code 64. Specifically, the individuals responsible for the DU ammunition program will be:

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(1) CAPT R. A. Turner NAVSEA 64	Director of Ammunition Systems Group
(2) CAPT R. D. Buchwald NAVSEA 641	Director of the Logistics Support Division
(3) Mr. J. B. Warfield NAVSEA 6411	Head Of Field Operations Branch
(4) CDR R. B. Bell, Jr NAVSEA 6412	Head of Facilities/Equipment Branch
(5) Mr. E. K. Sackrider NAVSEA 6413	Head of Management Programs Branch
(6) CAPT F. N. Howe NAVSEA 642	Director of Ammunition Management Division
(7) Mr. W. P. Swain NAVSEA 6421	Head of In-Service Branch
(8) Mr. W. R. Nicol NAVSEA 6422	Head of Production/Procurement Branch
(9) Mr. K. O. Range NAVSEA 6423	Head of Demil/Disposal Branch
(10) Mr. J. R. Paquette NAVSEA 6424	Head of Ordnance Requirement Branch

It should be noted that the people listed above may be replaced by others in the future but code functions will remain the same.

g. Records will be kept of DU ammunition procurement, storage, use, and disposition according to enclosure (1).

h. To assure that procedures and directives are carried out at storage installations and on ships testing DU penetrators, the program will be audited according to enclosure (1). A ship testing DU ammunition will expend approximately 1250 rounds from each PHALANX gun per quarter for Pre-Action Calibration and crew training. This involves firing the PHALANX gun at targets and checking all responses of the PHALANX fire control system mode.

3. Additional questions should be forwarded to NAVSEA CODE 642, Autovon 222-8746 or Commercial (202) 692-8746.

Robert E. Milligan
[illegible]

CONTROL AND ACCOUNTABILITY OF DEPLETED URANIUM (DU) AMMUNITION

1. General. This enclosure provides information concerning storage facilities, accountable officers, responsibilities, and policies for the requisitioning, reporting, control, and accountability of DU ammunition.

2. Policy. The ordnance officer at Navy activities holding DU ammunition will be designated as the DU accountable officer. The DU accountable officer will be responsible for the control and accountability of DU ammunition. DU ammunition will be controlled in the same manner as all conventional ammunition. SEA-64111F administers all NAVSEASYSCOM programs related to the control and accountability of ammunition.

3. Storage activities. DU ammunition will be stored for issue to Fleet units at those activities listed in tab (A).

4. Areas. DU ammunition will be found in any one of four areas.

a. In storage. DU ammunition will be stored in magazines in accordance with standard ammunition storage as set forth in OP-5 Vol 2.

b. In Initial Receipt Inspection. This inspection only occurs at NAVSEASYSCOM coastal ordnance handling activities listed in Tab (A), and applies to material received from a contractor. The material is inspected for damage in transit. After initial receipt inspection, the material is sent to storage.

c. In Segregation. Material returned from Fleet units to a NAVSEASYSCOM coastal activity goes to a segregation facility for identification and count verification. Segregation facilities are part of the coastal activities listed in tab (a). After segregation, the material is sent to storage.

d. In Transit. Material can be in transit between the following points:

(1) from initial receipt inspection to a magazine

(2) from a magazine to a Fleet unit

(3) from a Fleet unit to segregation

(4) from segregation to a magazine

(5) interstation movements

5. Recording and Control.

a. Each holder of DU ammunition will maintain local records to control material going into and out of the areas defined in paragraph 4.

(1) NAVSEASYSCOM coastal activities and NAVMAG Lualualei will maintain Asset and Expenditure records in the Ammunition Distribution and Control (AD&C) subsystem of the Naval Ordnance Management Information System (NOMIS). Asset and Expenditure records cover ammunition receipt, issue and expenditures, condition, lot, location, quantity and purpose. These activities will use NAVSEAINST 8015.1 for direction on documentation and procedures. IS-24, the AD&C Procedures Manual, provides instructions on the coding and input of data.

(2) All other ammunition storage activities will maintain Asset and Expenditure records in accordance with Chapter XII of SPCC P8010.12C.

(3) Fleet units will maintain Asset and Expenditure records in accordance with OP-4 Chapter VII.

b. In addition to maintaining local stock records, all holders of DU ammunition will report their stock levels to the Conventional Ammunition Integrated Management System (CAIMS), the Navy's centralized information system for ammunition assets. The two methods of reporting stock levels to CAIMS are Transaction Item Reporting (TIR) and Ammunition Transaction Reporting (ATR). TIR and ATR are a means of communication that describe any action, event or procedure that result in the transfer, expenditure, loss, gain, reconfiguration or change in material condition of non-nuclear

expendable ordnance material between ammunition reporting activities and CAIMS.

(1) For (TIR) activities. Report transactions into CAIMS in accordance with Chapter I, Section 2 of SPCC P8010.12C.

(2) For (ATR) activities. Report transactions into CAIMS in accordance with COMNAVLOGPACINST 8015.1 (for Pacific Fleet units) or CINCLANTFLTINST 8010.4 (for Atlantic and Mediterranean Fleet units).

6. Inventories and Audits.

a. Stock points will conduct inventories and audits of DU ammunition in accordance with NAVSUPINST 4440.115F. This instruction requires:

(1) An annual location survey which is a physical verification, other than actual count, between assets in storage and recorded location data on stock point records.

(2) An annual location audit which for ammunition is a match between local records and the CAIMS.

(3) An annual physical inventory which is a physical count of stock items for the purpose of verifying the recorded stock balance. Discrepancies require thorough causative research in order to account for the errors. Annual location surveys are not required for those items which have an annual physical inventory conducted.

b. Unaccountable losses and gains of DU ammunition require a security investigation and the preparation of a Missing, Lost/Stolen, or Recovered (MLSR) report in accordance with SECNAVINST 5500.4D. MLSR's are used to collect data on when, where, and how Navy property becomes missing, lost, or stolen. The ultimate goal of the MLSR requirement is to improve the Navy's physical security program.

7. Inter-Station Transportation. DU ammunition will be shipped between

activities. When in transit, the DU ammunition will not be on the local record but the CAIMS in-transit file will account for the DU ammunition.

a. When DU ammunition is issued, the shipping activity will post an issue to remove the DU ammunition from both the activity's local and CAIMS record.

b. Simultaneously, the CAIMS will place the DU ammunition into the CAIMS in-transit file. The CAIMS in-transit will show the item's stock number, the quantity, the shipping activity, and the receiving activity.

c. When the receiving activity posts a receipt for the DU ammunition, the DU ammunition is added to the local and CAIMS record for that activity. It is simultaneously deleted from the CAIMS in-transit file.

d. The following instructions provide direction on controlling documentation (i.e. DD1348-1) and local issue/receipt procedures.

(1) NAVSEAINST 8015.1 for NAVSEASYSCOM activities and NAVMAG Lualualei.

(2) CINCLANTFLTINST 8010.4 for Atlantic and Mediterranean Fleet activities.

(3) COMNAVLOGPACINST 8015.1 for Pacific Fleet activities, less NAVMAG Lualualei.

8. Requisitioning. Activities will requisition DU ammunition in accordance with Military Standard Requisitioning and Issue Procedures (MILSTRIP). Chapter 1, Section 5 of SPCC P8010.12 provides direction for requisitioning Navy ammunition.

TAB (A): DU Ammunition Storage Activities

NAVAL SEA SYSTEMS COMMAND ACTIVITIES.

1. Naval Weapons Station, Earle, N.J.
2. Naval Weapons Station, Yorktown, VA.
3. Naval Weapons Station, Charleston, S.C.
4. Naval Undersea Warfare Engineering Station, Keyport, WA.
5. Naval Weapons Station, Concord, CA.
6. Naval Weapons Station, Seal Beach, CA.

ATLANTIC FLEET ACTIVITIES.

1. Naval Station, Mayport, FL.
2. Naval Station, Guantanomo, Cuba
3. Naval Station, Roosevelt Roads, Puerto Rico
4. Naval Station, Rota, Spain
5. Naval Air Facility, Sigonella, Italy

PACIFIC FLEET ACTIVITIES.

1. Naval Air Station, North Island, San Diego, CA.
2. Naval Magazine, Lualualei, Oahu, HI.
3. Naval Magazine, Guam
4. Naval Magazine, Subic Bay, Phillipines

TRANSPORTATION OF DEPLETED URANIUM AMMUNITION

a. The DU in the all-up configuration as a 20mm round of ammunition is considered to be a manufactured article. The DU is in a nondispersible form as a component part of the round.

b. All shipments to and from storage locations will be in M548 20MM ammunition containers. These containers are steel boxes which will prevent any leakage of radioactive materials under conditions normally incident to transportation.

c. The dose rate at any point on the external surface of the container will not exceed 0.5 milirem per hour (to be verified by the Radiation Protection Officer (RPO) on a test basis).

d. The curie limit per container will not exceed the Transport Group III quantity limit of 3 at any time. There will be no significant removable radioactive surface contamination on the exterior of the containers.

e. Title 49 Code of Federal Regulations (CFR) specifies requirements for transportation of hazardous material. The 20mm round with the DU contains two separable hazards (i.e. Radioactive material and Class C explosives). Section 173.391 (b) exempts from specification packaging, marking, and labeling for the radioactive hazard insofar as the criteria specified therein is met. The 20mm rounds (with DU), packaged as described above, meet those criteria. Section 173.101 exempts the 20mm round (with DU) from labeling, but requires outside packages to be marked "Small Arms Ammunition" that complies with MIL-STD-129 and shipping papers must comply with requirements of Sections 172.101 and 172.202. Detailed transportation safety data for this item is contained in NAVSEA OP 2165, Volume 2 (listed by the Department of Defense Identification Code (DODIC), i.e., A675).

f. In addition to the above, all containers will be marked/ labeled in accordance with MILSTD 129H. The box ID number shall also be included on the exterior of the container.

g. In accordance with Section 173.391 (b) and Title 10 CFR Section 20.205 (B) (1) (i) NRC regulation, no shipping or receipt monitoring surveys are required.

Code Ident
10001

WS 10765B
13 Oct 1979
Superseding
WS 10765A

NAVAL SEA SYSTEMS COMMAND
DEPARTMENT OF THE NAVY
CRITICAL ITEM PRODUCT SPECIFICATION
CARTRIDGES, 20MM DISCARDING SABOT
MARK 149 MOD 1

1. SCOPE

1.1 This specification establishes the requirements for manufacture and acceptance of 20mm Discarding Sabot Cartridges, MARK 149 MOD 1.

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on the date of invitation for bids or request for proposal, form part of this specification to the extent specified herein.

SPECIFICATIONS

WS 19781	Critical Item Product Function Specification, Propellant, Ball, for Cartridge, 20mm (DS), MK 149 MOD 0
WS 18782	Weapon Specification for Painting, Marking, and Lettering of Naval Gun Ammunition

STANDARDS

MIL-STD-1167	Military Standard Ammunition Data Card
MIL-STD-1168	Lot Numbering of Ammunition
MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-1385	Preclusion of Ordnance Hazards in Electromagnetic Fields

DRAWINGS

NAVSEA

5366592	Cartridge, 20mm (DS), MARK 149 MOD 1
5366591	Projectile Assembly, 20mm (DS) MARK 68 MOD 1
5366594	Projectile Assembly, Subcaliber
5366590	Sabot, Discarding

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ENCLOSURE (3)

5366596	Pusher Plug Assembly, 20mm
2925503	Propellant
2923566	Case Assembly, Cartridge
3236875	Special Interface Gage

ARMY

11075229	Barrel, 20 mm
7548066	Primer, Electric, M52A3B1
7553815	Case, Cartridge, 20mm, M103
5172157	Method of Packing 100 Cartridges, 20mm, In MARK 7 Type Links (M548 Container)

OTHER PUBLICATIONS

Department of Defense

DOD 4145.26M Contractors Safety Manual

Military

MIL HDBK 53 Guide For Sampling Inspection

Nuclear Regulatory Commission

"The Code of Federal Regulations", Title 10, Part 40/Licensing of Source Material

Naval Sea Systems Command

NAVSEA Note 4855

Navy Department

OP 5 Ammunition and Explosives Ashore

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. REQUIREMENTS

3.1 Item definition. The 20 millimeter (mm) cartridge specified herein consists of a projectile assembly (MARK 68 MOD 1), a cartridge case with an electric primer, and a propellant (see Figure 1). This assembly is hereinafter referred to as the cartridge. Principal components of the MARK 68 MOD 1 projectile assembly are a pusher plug assembly, a subcaliber projectile (commonly referred to as a penetrator), and a discarding

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sabot. When fired, the rotating band of the pusher plug assembly engages the barrel rifling, imparting spin to the pusher plug and sabot. Set back forces cause indentation of the pusher plug by the slotted rear surface of the penetrator, coupling the two, and the pusher plug spin is imparted to the penetrator. Upon muzzle exit, centrifugal force and muzzle blast cause the sabot to split into four pieces and separate from the penetrator. The pusher plug assembly then drops away and the penetrator travels on to the target.

3.2 Workmanship. The cartridge shall be manufactured in accordance with this specification and an approved government procurement documentation set. The cartridge shall be manufactured in accordance with good workmanship practices common to the ordnance industry. Particular care shall be taken that all components are clean, free from grease, dirt, corrosion, chips, or foreign material. Components with obvious defects or handling damage which could affect performance of the cartridge or test weapons shall not be used. No interpretation of any part of this or other applicable documents shall by construed to relieve the contractor of his responsibility to furnish cartridges with the required degree of quality and workmanship.

3.3 Inspection Requirements. Sample cartridges shall be submitted to visual inspection, gaging, and weighing (4.3.4). Major and minor characteristics shall be inspected to AQL's of 1.0 and 2.5 percent defective, respectively.

3.4 Performance

3.4.1 Pusher plug extraction force. The force required to separate the pusher plug from the case shall not be less than 900 nor more than 2100 lb. (4.4.1)

3.4.2 Pusher plug rotation. The torque required to rotate the pusher plug with respect to the case shall be more than 10 inch-pounds. (4.4.2)

3.4.3 Velocity requirements. The average corrected velocity (4.4.3.6) shall be 3700 ± 35 ft/sec. The standard deviation of the measured test velocities shall be 28 ft/sec or less.

3.4.4 Waterproof requirements. The average corrected velocity (4.4.4) of the waterproof test cartridges shall be within 100 ft/sec of the average corrected velocity of the dry test cartridges of 3.4.3. The standard deviation of the measured test velocities shall be 28 ft/sec or less.

3.4.5 Action time. The action time of the cartridge shall not exceed 4.0 ms. (4.4.5)

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3.4.6 Pressure. The average of the pressures measured for the test cartridges shall not exceed 58000 psi. Standard deviation of the pressure measured shall not exceed 3000 psi. (4.4.6)

3.4.7 Accuracy. The standard deviation of dispersion Sd (4.4.7.5) shall be less than or equal to 1 milliradian. In each set of firings, 50 percent or greater of the projectiles fired shall fall within a circle of radius corresponding to 1.2 milliradians, with center coordinates ($\overline{X}$, $\overline{Y}$).

3.4.8 Target penetration.

3.4.8.1 Residual velocity. The median of the corrected residual velocities (4.4.8.2) shall not be less than 1640 ft/sec. None of the corrected residual velocities shall be less than 1340 ft/sec.

3.4.8.2 Residual weight. The median of the residual weights (4.4.8.7) shall not be less than 770 grains. None of the residual weights shall be less than 560 grains.

3.4.9 Function requirements. Defects encountered in the function tests (4.4.9) shall not exceed the values specified in Table I.

Table I. Firing Defects per Preproduction Lot

Defects	Maximum Allowable Defective Units
Misfire, caused by	
(a) Excessive primer seating depth	2
(b) Metal slivers across primer insulator	2
(c) Open primer circuit	2
(d) Missing or obstructed case primer vent	2
(e) Missing primer or propellant or insufficient propellant	0
(f) Partially burned propellant	0
(g) Primer actuation without propellant ignition	0
(h) Other causes not listed	0
Ignition after the bolt has been unlocked and extraction has been initiated	0
Projectile remaining in bore	0
Primer defects	
(a) Evidence of small leak around primer	7
(b) Evidence of large leak around primer	1

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ENCLOSURE (3)

Table I. Firing Defects per Preproduction Lot Sample (Continued)

Defects	Maximum Allowable Defective Units
(c) Perforated or missing primer button	1
(d) Loose primer	1
(e) Blown primer	0
Case Casualty	
(a) Circumferential rupture	
(1) Partial; neck, shoulder, or body	2
(2) Partial; base	0
(3) Complete	0
(b) Longitudinal split	
(1) Neck and shoulder	5
(2) Body; forward	2
(3) Body; center	1
(4) To head	1
(5) Through head	0
(c) Metal sheared from the exterior of the case	0
Failure to extract; including sheared rim	0
Failure to chamber	0
Gun stoppage from ammunition defects not listed above	0

3.5 Unlisted firing defects. The lot shall be rejected if a malfunction or casualty not covered by this specification, occurring in any firing test, indicates that the cartridge is unsuited for its intended purpose.

3.6 Retest. Retests shall be made only as approved by the procuring activity.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspections and tests.

4.1.1 Responsibility for component inspection. Except for government furnished materials, the cartridge supplier is responsible for ensuring that all components of the cartridge meet the requirements of applicable drawings and specifications.

4.1.2 Responsibility for assembly inspections. Unless otherwise specified in the contract or purchase order, the cartridge supplier is

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responsible for the performance of all inspections required during and upon completion of assembly.

4.1.3 Responsibility for tests. Unless otherwise specified in the contract or purchase order, the designated test activity is responsible for the performance of all tests specified herein.*

4.2 Classification of characteristics. The characteristics to be verified are classified as Critical, Major, or Minor in accordance with NAVSEA Note 4855. Critical characteristics are identified by the symbol (CX) and Major characteristics by the symbol (MXXX). The number following the classification symbol indicates the serial number of the requirement. Requirements which are not annotated with a classification symbol are classified Minor.

4.3 Quality conformance inspection. The quality conformance inspection shall verify that all characteristics of Section 3, REQUIREMENTS, and Section 5, PREPARATION FOR DELIVERY, of this specification have been met.

4.3.1 Critical characteristics of components. Prior to assembly, all components shall be inspected for critical defects. Any component having a critical defect shall be rejected.

4.3.2 Critical characteristics of assembly. Assembly procedures shall not introduce defects identified as critical in component drawings or specifications. All cartridges shall be inspected for such defects. Any cartridge having such a critical defect shall be rejected.

4.3.3 Sampling for tests and inspections.

4.3.3.1 Initial production lot. Prior to beginning of regular production, a lot of 800 cartridges shall be assembled and samples submitted to the inspections of 4.3.4 and the tests of 4.4. Sample cartridges shall be randomly selected from the lot in accordance with MIL-HDBK-53 and forwarded to the designated test activity. This pre-production lot shall be manufactured using the same materials, equipment, processes, and procedures as will be used in regular production.

4.3.3.2 Inspection lot. An inspection lot consists of not less than 10,000 nor more than 50,000 cartridges which:

a. Have been assembled by one activity, in one unchanged process, in accordance with the same drawings and drawing revisions, and the same specification and specification revision.

b. Use parts and assemblies having one manufacturer's symbol and one interfix number (see MIL-STD-1168).

* Designated test activities are identified on paragraph 2.d of cover letter.

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c. Use propellant from one index.

d. Use projectiles (penetrators) from one lot.

e. Use cases from one lot.

f. Use primers from one lot.

Inspection lots may be assembled from mixed lots of components with permission of the procuring activity.

Sample cartridges shall be randomly selected from each inspection lot in accordance with MIL-HDBK-53 and subjected to the inspections of 4.3.4 and selected tests of 4.4. Samples required for the tests of 4.4 shall be shipped to the designated test activity.

4.3.4 Visual inspecting, gaging, and weighing. The supplier shall submit cartridges to visual inspection, gaging, and weighing in accordance with Table II. Sampling shall be in accordance with MIL-STD-105. The requirements of MIL-STD-105 pertaining to normal and tightened inspection apply. Failure to meet the requirements of 3.3 shall be cause for rejection of the lot.

Table II. Visual, Gaging, and Weighing Requirements

No.	Major Characteristics
101	Case to projectile crimp missing
102	Split or perforated case
103	Loose projectile assembly or components
104	Total weight between 4500 and 4700 grains
105	Sabot cracked or split
106	Cartridge profile incorrect (i.e., required more than 80 pounds force to insert into special interface gage, Dwg 10001-3236875
107	Exceeds maximum overall length
108	Incomplete or improperly located crimp
109	Primer improperly seated
110	Lacquer on primer
111	Waterproofing missing around primer or case mouth
112	Loose projectile assembly or component
113	Primer resistance less than 500 ohms or greater than 1,200,000 ohms.
	Minor Characteristics
	Foreign matter
	Marking incorrect or illegible
	Dent or scratch in case
	Damaged rotating band or sabot

4.4 Tests. All tests of this section are performed on the preproduction lot (4.3.3.1). All tests of this section except the penetration and function tests of 4.4.8 and 4.4.9 are performed on inspection lots (4.3.3.2).

4.4.1 Pusher plug extraction test. Twenty test sample cartridges shall be tested in a tensile test machine of suitable capacity, which will register accurately the force required to extract the pusher plug from the cartridge case. Force shall be applied to the case at a controlled test head travel rate of 0.125 to 0.25 inches per minute. Failure of two or more sample cartridges to meet the minimum force requirement for extraction (3.4.1) shall reject the lot. Failure of four or more sample cartridges to meet the maximum extractive force requirement (3.4.1) shall reject the lot.

4.4.2 Pusher plug rotation test. Twenty test sample cartridges shall be marked with a light scratch extending across the pusher plug onto the case neck. With the case fixed in an appropriate fixture, torque up to 10 inch-pounds shall slowly be applied to the pusher plug, about the axis of the cartridge. Failure of two or more samples to meet the requirements of 3.4.2 shall reject the lot.

4.4.3 Velocity measurements. Twenty test sample cartridges shall be fired in a 20mm Mann barrel, Dwg. No. 11075229, 11 Apr 1979, and velocities measured. These values are compared with the velocities obtained using 10 reference cartridges assembled by the test activity. Failure to meet the requirements of 3.4.3 shall be cause for rejection of the lot.

4.4.3.1 Reference cartridges. Reference cartridges shall be assembled by the test activity from parts provided by the supplier. Components other than propellant used shall be from the same lots as used in the ammunition lot under test. Assembly shall be as specified herein and in the assembly drawing specified herein. Projectile assemblies MARK 68 MOD 1 shall be screened by weight and those used in the assembly of reference cartridges shall weigh 1440 ± 5 grains. Propelling charge used shall be from the propelling charge lot established as a Master Lot by WS 19781. Weight of propelling charge shall be within ± 0.5 grains of the nominal weight established for the Master Lot.

4.4.3.2 Barrel condition. The acceptability of the barrel used for the velocity measurements shall be based on the average velocity obtained with the reference cartridges. The barrel is acceptable only if this average velocity is 3700 ± 35 ft/sec. No barrel shall be used which shows cracks, stripped lands, inordinate erosion, or other conditions indicative of questionable serviceability. The barrel shall be cleaned, cooled, and maintained in accordance with established procedures.

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4.4.3.3 Temperature conditioning. Cartridges shall be conditioned at a temperature of 70 ± 2°F for a period of at least 24 hours prior to firing and shall be held at that temperature as long as possible prior to insertion in the gun.

4.4.3.4 Screen locations. Projectile velocity shall be measured using lumiline screens or other similar devices. Screens shall be positioned at 28 and 128 feet from the gun muzzle.

4.4.3.5 Firing procedure. At least three rounds shall be fired to foul and warm the barrel at the start of a test, and after the barrel has been cooled or cleaned. All reference and test cartridges shall be carried to the gun in a base-down position, slowly rotated to a projectile-down position, stopped momentarily, returned to the base-down position, then rotated slowly to the horizontal position and inserted into the test barrel. Insertion and subsequent breech closure shall be made so that the propellant is disturbed as little as possible.

The cadence of the firing shall be two minutes ± 10 seconds per round. This shall include a dwell time of the cartridge in the warm chamber not to exceed 30 seconds. A dwell time (cartridge in chamber) of 20 seconds is the goal of the firing cadence.

Reference cartridges shall be randomly mixed among the 20 test cartridges.

4.4.3.6 Calculations. Should velocity data not be obtained on one round, that round shall be ignored. However, the test shall not be considered valid unless valid data is obtained on at least 20 test cartridges and 10 reference cartridges.

The average corrected velocity ($\bar{V}$) shall be computed as follows:

$$\bar{V} = \bar{V}_T + (3700 - \bar{V}_R)$$

where V_T = average muzzle velocity from the test samples

V_R = average muzzle velocity from the reference cartridges

The average corrected velocity shall meet the requirements of 3.4.3.

4.4.4 Waterproofness test. Twenty cartridges shall be immersed in water at 70 ± 2°F for 24 hours, then fired in a 20mm Mann barrel and muzzle velocities measured. Failure to meet the requirements of 3.4.4 shall be cause for rejection of the lot.

4.4.4.1 Test conditions. Reference cartridges shall be assembled as described by 4.4.3.1. Barrel condition shall be as described by 4.4.3.2.

Screen locations shall be as described by 4.4.3.4. Firing procedure shall be as described by 4.4.3.5 except as follows: test cartridges shall be preconditioned to a temperature of 70 ± 2°F for a minimum period of two hours. They shall then be submerged in a water bath at 70 ± 2°F for a period of 24 hours. Cartridges shall be placed horizontally under the bath surface with the water one inch to one and one-fourth inches above the case rim. After 24 hours has elapsed, the cartridges shall be removed, wiped dry, and set base down in a room or box with the temperature conditioned to 70 ± 2°F. A minimum of two hours shall be allowed for this conditioning period.

4.4.5 Action time tests. Forty test sample cartridges shall be fired in a 20mm Mann barrel to determine the time difference between the application of the firing voltage and emergence of the projectile assembly from the muzzle. Failure to meet the requirements of 3.4.5 shall be cause for rejection of the lot.

4.4.5.1 Barrel condition. No barrel shall be used which shows cracks, stripped lands, inordinate erosion, or other conditions indicative of questionable serviceability. The barrel shall be cleaned, cooled, and maintained in accordance with established procedures.

4.4.5.2 Firing sequence. At least two rounds shall be fired as an equipment check when the weapon is first put into service or when it has been cleaned or cooled. The test shall be fired single shot in an even sequence with approximately 2 minutes or less between shots.

4.4.5.3 Temperature conditioning. Twenty of the 40 test cartridges shall be conditioned at -20°F ± 2°F for a period of at least 24 hours prior to firing and shall be held at that temperature as long as possible prior to firing. The remaining 20 test cartridges should not be conditioned other than at ambient temperature.

4.4.6 Pressure tests. Twenty test cartridges shall be fired in a 20mm Mann barrel and chamber pressures measured using copper crusher gages. Failure to meet the requirements of 3.4.6 shall be cause for rejection of the lot.

4.4.6.1 Barrel condition. No barrel shall be used which shows cracks, stripped lands, inordinate erosion, or other conditions indicative of questionable serviceability. The barrel shall be cleaned, cooled, and maintained in accordance with established procedures.

4.4.6.2 Gage location. The barrel shall be drilled for insertion of a copper crusher gage with a .206-inch diameter hole with the center 1.812 inches from the barrel breech face. The cartridge case shall be drilled with a corresponding hole, with drilling carefully controlled to prevent burrs on the break-through surface. A piece of tape shall be placed over

this hole ~~and not removed until just~~ prior to chambering the cartridge. A scribe mark or other index on the case shall be used to assure that the case hole matches the hole in the barrel.

4.4.6.3 Firing procedure. Prior to and during the firing sequence, the pressure gages shall be serviced in accordance with accepted procedures. When removing the tape from the case pressure hole, care must be exercised that no portion of the propellant powder charge adheres to the tape or is otherwise lost. Firing procedure shall be as specified in 4.4.3.5 except no reference cartridges are required.

4.4.6.4 Temperature conditioning. Cartridges shall be conditioned at a temperature of 70 ± 2°F for a period of at least 24 hours prior to firing and shall be held at that temperature as long as possible prior to insertion in the gun.

4.4.7 Accuracy tests. Fifty test sample cartridges shall be fired in a 20mm Mann barrel to determine the average dispersion ($\bar{D}$). Test conditions shall be as described below. Failure of the ammunition to meet the requirements of 3.4.7 shall be cause for rejection of the lot.

4.4.7.1 Barrel condition. The acceptability of the barrel used for the accuracy test shall be based on the average velocity obtained with reference cartridges (4.4.3.1). The barrel is acceptable only if this average velocity is 3700 ± 35 ft/sec. Firing of reference cartridges need not be conducted concurrently with the accuracy tests. Data from a recent firing using reference cartridges is acceptable provided no more than 200 rounds have been subsequently fired in the barrel. No barrel shall be used which shows cracks, stripped lands, inordinate erosion, or other conditions indicative of questionable serviceability. The barrel shall be cleaned, cooled, and maintained in accordance with established procedures.

4.4.7.2 Grouping. The 50 test samples shall be separated into five groups of 10 each, and a separate target used for each of the five sets.

4.4.7.3 Target. The target shall be vertically positioned at a distance of 300 ft or more from the muzzle. The target should be not less than 48 x 48 inches.

4.4.7.4 Firing sequence. At least three rounds shall be fired to warm and foul the barrel at the start of the test, and after the barrel has been cooled or cleaned. Each set of 10 cartridges shall be fired in an even sequence with approximately 90 seconds between shots. Consideration is not given to the position of the propellant in the cartridge case except that the handling of the ammunition from shot to shot should be reasonably uniform.

4.4.7.5 Calculation of dispersion. The standard deviation of dispersion Sd shall be computed from the standard deviation of the X-coordinates and the Y-coordinates of the rounds fired:

Standard deviation of X-coordinates $Sx = \sqrt{\frac{\Sigma(Xi-\overline{X})^2}{N-1}}$ (ft)

Standard deviation of Y-coordinates $Sy = \sqrt{\frac{\Sigma(Yi-\overline{Y})^2}{N-1}}$ (ft)

Standard deviation of dispersion $Sd = \left[\frac{Sx + Sy}{2}\right]\left[\frac{1000}{\text{actual target range (ft)}}\right]$

Where, (1) the x-axis is the horizontal line through the center of the lowest shot hole in the target. (2) The Y-axis is the vertical line through the left-most shot hole in the target. (3) All shots have (Xi,Yi) coordinates measured from the point where the X and Y axes intersect. (4) $\overline{X}$ is the average X coordinate: $\overline{X} = \frac{\Sigma Xi}{N}$. (5) $\overline{Y}$ is the average Y coordinate: $\overline{Y} = \frac{\Sigma Yi}{N}$. (6) N is the number of shots fired. All measurements shall be made from the centers of the impact holes.

The standard deviation of dispersion shall meet the requirements of 3.4.7.

4.4.8. Target penetration tests. Test sample cartridges from the preproduction lot shall be fired in a 20mm Mann barrel to determine the capability of the ammunition to penetrate a standard target. Firings shall be conducted until a total of 15 successful firings have been completed.

4.4.8.1 Target description. The target shall be an arrangement of foam and metal panels designated S-2 MOD 2 as shown by Figure 2. The target shall be positioned with the center of the front panel at a distance of 200 feet from the gun muzzle.

4.4.8.2 Velocity measurements. Projectile velocity shall be measured no more than 10 feet in front of the target (designated V_I), and no more than six feet behind the target (designated V_R). Devices used for velocity measurements must not disturb projectile flight. Light screens, flash X-ray, or microflash photography are recommended. Residual velocity measurement must be taken with equipment which will selectively measure projectile remnant velocity, ignoring smaller target spall fragments. Composite contact panels large enough to intercept remnants exiting the target at up to 20° from line of fire are recommended.

Residual velocities shall be corrected by the following formula.

$$V_{RC} = V_R \left[\frac{1.06 \times 10^7}{V_I^2 \quad 2.69 \times 10^6} \right]^{1/2}$$

where V_{RC} = corrected residual velocity (ft/sec)

V_R = measured residual velocity (ft/sec)

V_I = measured impact velocity (ft/sec)

Failure of the projectile to meet the residual velocity requirements of 3.4.8.1 shall be cause for rejection of the lot.

4.4.8.3 Yaw measurement. Some means shall be provided for detecting pitch and yaw of the projectile within three feet of target entry. Detection devices must have a negligible effect on projectile flight. Orthogonal flash X-ray and orthogonal microflash photography are recommended.

4.4.8.4 Projectile recovery. Beyond the penetration target and residual velocity equipment the projectiles shall be caught in a suitable medium which minimizes further loss of mass. (Stacked sheets of plywood have proven successful in developmental tests.) Projectiles shall be removed from the recovery medium, cleaned, examined, and weighed.

4.4.8.5 Visual assessment. Visual assessment shall include examination of penetration targets and recovered projectiles. Note should be made of the path followed by the projectile through the target, evidence of projectile tumbling, target damage, and evidence of projectile breakup.

4.4.8.6 Unsatisfactory firings. Impacts occurring under the following conditions shall be considered unsatisfactory, and shall be rejected as data points.

a. Any projectile which strikes within one caliber of the nearest edge of previous impacts in three or more target panels. The measurement shall be made in terms of the caliber of the larger hole.

b. Any projectile which strikes within two projectile diameters of the edge of three or more target panels.

c. Any projectile which strikes any of the target support structure.

d. Any projectile which misses any of the target panels.

e. Any projectile which shows indication of more than 5 degrees yaw upon target entry.

f. Any projectile with V_I less than 3550 or more 3750 ft/sec.

4.4.8.7 Residual weight measurement. Projectiles shall be removed from the recovery medium, cleaned and weighed. Failure of the projectiles to meet the requirements of 3.4.8.2 shall be cause for rejection of the lot.

4.4.9 Function test. The purpose of the function test is to determine whether the ammunition will perform satisfactorily under normal operating conditions. This test is required only for the preproduction lot. One hundred fifty sample cartridges shall be fired fully automatic in bursts of 50 rounds, in an M61A1 20mm gun at a firing rate of 3000-4000 rounds per minute. Failure of the projectiles to meet the requirements of 3.4.9 shall be cause for rejection of the preproduction lot.

4.4.9.1 Equipment. None of the barrels used in the function test shall have erosion readings greater than .00875, as measured by an M-10 Bore Erosion Gage. No barrel shall be used which shows cracks, stripped lands, inordinate erosion, or other conditions indicative of questionable serviceability. The barrels shall be cleaned, cooled, and maintained in accordance with established procedures.

The M61A1 gun used shall have fired no more than 90,000 rounds. The gun and accessory equipment shall have been cleaned, serviced, maintained and adjusted in accordance with established procedures.

The test cartridges shall be installed in MARK 7 MOD 1 or M14A2 20mm links.

4.4.9.2 Temperature conditioning. Fifty of the test sample cartridges shall be conditioned at -20 ± 20°F, 50 at 70 ± 2°F, and 50 at 150 ± 2°F, for a period of at least 24 hours prior to firing and shall be held at the conditioned temperature as long as possible prior to firing. These sets of 50 cartridges shall be fired independently, each set to be fired in one 50-round burst.

4.4.9.3 Test procedures. The cartridges shall be fired fully automatic in an M61A1 20mm gun at a firing rate of 3000-4000 rounds per minute. When a malfunction occurs, effort will be made to determine whether it was caused by the ammunition or by the weapon. If caused by the weapon, corrective action shall be taken and firing resumed without penalty to the ammunition lot. If caused by the ammunition, accept-reject criteria shall be determined from Table I.

4.4.9.3.1 Velocity measurements. Projectile velocities shall be measured and recorded. The procedures of 4.4.3.4 shall be used.

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4.4.9.3.2 Cyclic rate. The rate of fire used shall be determined and recorded for information purposes. Any suitable measuring technique yielding ± 2 percent error is acceptable.

4.5 Reports required.

4.5.1 Test report. Upon completion of all tests, a test report shall be prepared by the test activity and submitted to the procuring activity within 30 days. The test report shall include but not be restricted to the following data:

a. Gun and barrel MARK and MOD, serial numbers and state of wear.

b. Lot number of ammunition under test, and of the components used in their assembly.

c. Results of all tests, conclusions, and description of ammunition defects.

4.5.2 Inspection report. Upon completion of all inspection, the supplier shall provide an inspection report to the procuring activity within 30 days. The report shall include but not be restricted to the following data:

a. Lot number of ammunition under inspection, and of the components used in their assembly.

b. Results of all inspections and subsequent conclusions.

c. Disposition of rejected components or assemblies.

5. IDENTIFICATION AND PREPARATION FOR DELIVERY

5.1 Lot identification. Each cartridge and each packed ammunition lot shall be identified in accordance with WS 18782 and MIL-STD-1168. Each packed lot shall be further identified by a federal stock number assigned by the procuring agency. Data cards shall be supplied in accordance with MIL-STD-1167.

5.2 Preparation for delivery. Instructions for preparation for delivery are found in 4172157.

6. NOTES

6.1 Intended use. 20mm cartridges MARK 149 MOD 1 are intended for use in the PHALANX Close-In Weapons System MARK 15 MOD 0 against lightly armored targets.

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6.2 Ordering data.

6.2.1 Procurement requirements. Procurement documents shall specify the following:

a. Applicable data list, including revision number.

b. Title, date, and number of this specification.

c. The test activity to which the test samples are to be sent, and the number of cartridges and components required.

d. The cognizant activity to which the test and inspection reports are to be sent.

e. Disposition of sample cartridges used in the acceptance tests.

f. Method of shipment of material.

g. Disposition of inspection data.

h. Data card requirement. Distribution shall be specified in the contract or purchase order.

i. Requirement for qualification of propellant.

j. Action to be taken in case of lot rejection. Retest of lots shall only be done as specified by the procuring activity.

k. Action to be taken in case of rework or repairs. Rework of nonconforming cartridges may be approved if such cartridges, components or assemblies are free of latent defects or weaknesses which may have been occasioned by such rework. The procuring activity may require segregation and separate presentation of such ammunition.

6.2.2 Contract data requirements. Commercial contracts shall incorporate a DD Form 1423. Work requests to government activities shall incorporate data requirements in an appropriate manner.

6.3 Periodic lot sample. The procuring activity may waive the requirement for a lot sample if the supplier has recently demonstrated his ability to produce this item. The contracting officer will notify the testing facility when to proceed with firing tests.

6.4 Combining tests. Firing tests may be performed concurrently on the same sample cartridges provided that the conditions of the various tests can be met concurrently.

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6.5 Safety precautions. The assembly and handling of the items covered by this specification involve hazardous operations and require suitable safety precautions. Information on the hazards of handling depleted uranium are contained in "The Code of Federal Regulations", Title 10 Part 40/Licensing of Source Materials. Information concerning the handling of items susceptible to electromagnetic radiation is contained in MIL-STD-1385. Safety during loading, handling, shipment, storage, and testing shall also be in accordance with DOD 4145.26M and OP 5.

Custodian

Preparing Activity
Naval Surface Weapons Center
Dahlgren, Virginia 22448

ENCLOSURE (3)

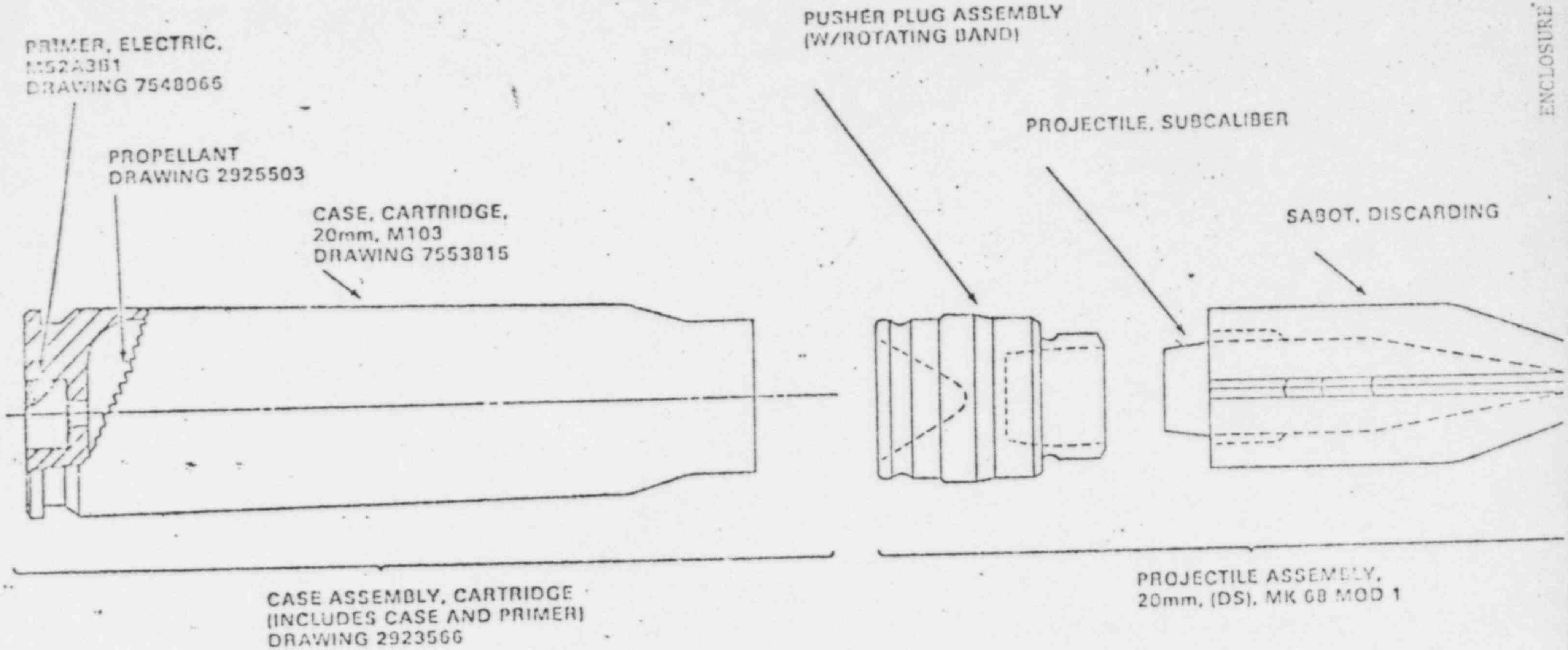

FIGURE 1. CARTRIDGE, 20mm (DS), MK 149 MOD 1

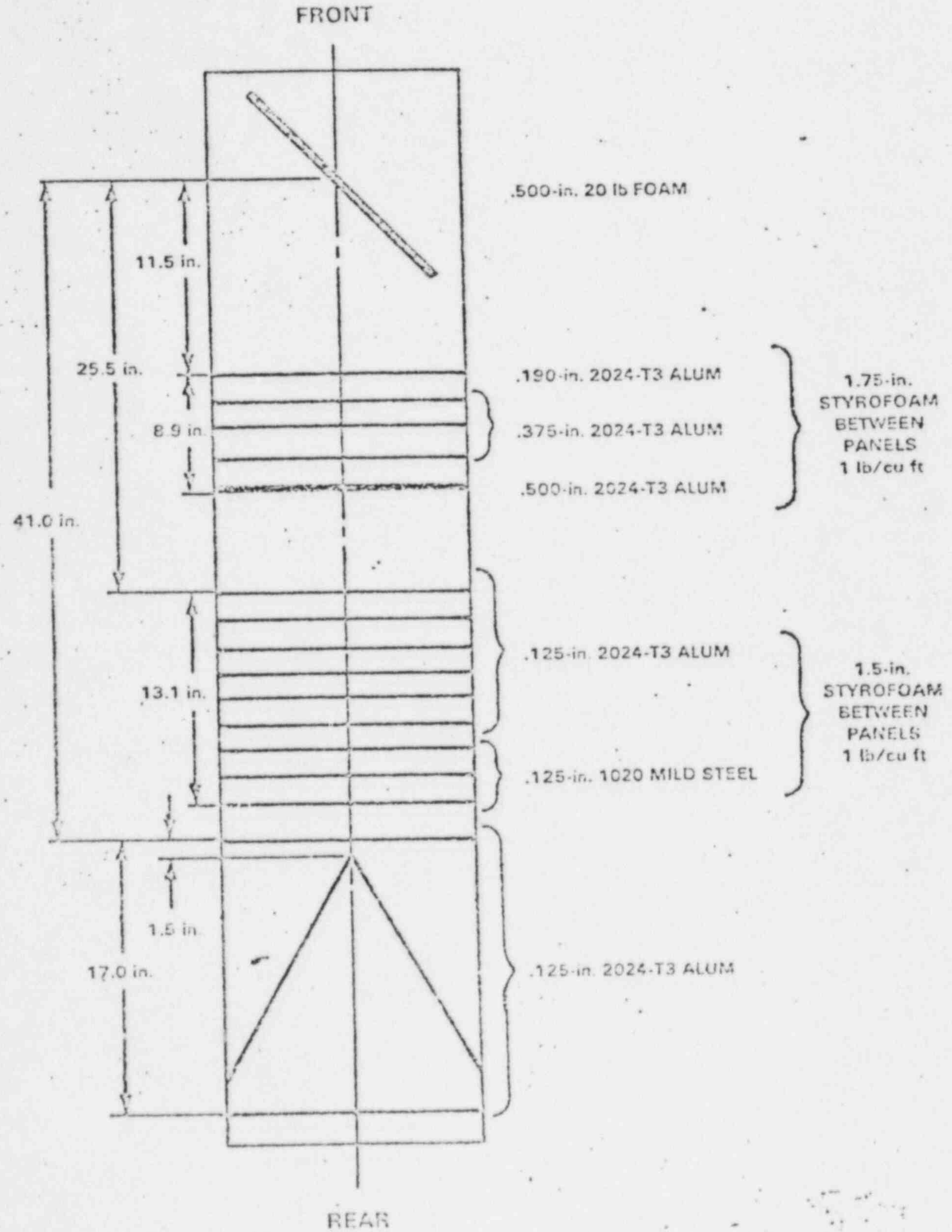

FIGURE 2. S-2 MOD 2 PLATE ARRAY

ENCLOSURE (3)

EFFECTS OF DEPLETED URANIUM AMMUNITION ON THE ENVIRONMENT

1. PRIMARY EFFECTS ON THE ENVIROMENT

The primary potential environmental impacts of PHALANX are related to the use of DU in the MK149 specialized round. The use of DU does not present a significant hazard to man or the environment; however, because of concern about the chemical toxicity and radioactivity of DU, the effects on the environment of these properties of DU are addressed in the following paragraphs. While this section is primarily concerned with "what would happen if DU were released to the environment", Section 2 deals with possible release modes, or "how (and how much) DU can be relased to the environment".

The potential effects of DU on man, air, water, and the food system are summarized below in Section 1.1 through 1.4.

1.1 Effects on Man

There are negligible effects on man exposed to DU radiation. Potentially more serious effects may result from ingestion, inhalation, or implantation (under the skin) of particles of DU released to the environment. The likelihood of these modes of entry into the body is very low; nevertheless, a description of the effects from each is provided below.

1.1.1 Ingestion

Hazards from ingestion arise more from the chemical toxicity of DU than from its radioactive properties. Ingestion of DU particles may result in poisioning.

Maximum permissible intake for natural uranium due to its chemical toxicity has been set by the NCRP at 150 milligrams (ingested over a

period of two days). The limit for DU would most likely not be any higher than this value since its chemical properties are similar to those of natural uranium.

The effects of ingesting DU can be assessed through the use of a comparative example. Ingestion of DU would most likely occur by drinking water containing traces of it. Maximum Permissible Concentrations (MPC)* of uranium in the water supply (based on its radioactive properties) are established in 10 CFR 20. Based on the low solubility of uranium in water and the relatively large MPC (3.0×10^{-5} uCi/cm^3), large quantities of uranium can be deposited in water before approaching the MPC. For example, a worst case situation can be postulated in which 5700 PHALANX projectiles (equivalent to about 0.4 metric tons of DU) are deposited in a small pond (1000 m^2 area) holding 1500 m^3 of water. After 100 years (which provides ample time for release of uranium through corrosion), the concentration of uranium in the pond water would be 8.3×10^{-7} uCi/cm^3 (Ref. 1), which is much less than the prescribed MPC.

1.1.2 Inhalation

Inhalation of small DU particles would be the most likely mode of entry into the body. NCRP's recommended maximum intake (based on chemical toxicity) of soluble uranium compounds by inhalation is 2.5 mg in one day. Environments with air concentrations of this magnitude are not likely considering the regulations imposed on facilities where high dust concentrations would most probably occur.

Occupational exposure of workmen under levels substantially higher than the MPC level for air (1.0×10^{-10} uCi/cm^3) over a period of 20 years have not been observed to show any evidence of uranium injury from

either radiation exposure to the lungs or from kidney effects due to uranium toxicity (Ref 1). The reason for these negligible effects may be attributed to the fact that the airborne uranium dust particles were too large to be respired and thus reach the lung interior (Ref 1). Overdoses in accidental occupational exposures from soluble uranium material can produce evidence of kidney injury as in ingestion. The general experience, however, with workmen exposed to air concentrations at or slightly above MPC levels has been acceptable. Ailments such as chronic renal injuries, lung cancer, and other radiogenic tumors have not been evident. The lack of reports of adverse effects in man from occupational exposures to uranium compounds for prolonged periods emphasizes the low level of risk from this material and the effectiveness of current industrial hygiene systems.

1.1.3 Implantation

On occasion, particles of uranium can penetrate the skin, particularly during operations where uranium metal is machined or uranium compounds are handled. The effects of implantation have not been demonstrated to be serious, as no poisioning either locally or in other locations of the body has been reported (Ref 1). The treatment of implantation is similar to that applied to steel or wood splinters.

*Maximum Permissible Concentrations (MPC) are safe limits of radiation exposure below which no biological harm to man is evident. MPC values in air and water are derived by calculations that relate them to permissible body burdens and constitute criteria against which measurements taken of the environment may be compared. MPCs represent concentrations averaged over a period of time, usually quarterly, that should not be exceeded.

TABLE A

PERMISSIBLE URANIUM CONCENTRATIONS IN AIR AND WATER
(ABOVE NATURAL BACKGROUND RADIOACTIVITY LEVELS)

Applicable Area *		Recipient Medium Air**	Water**
Restricted	U+	1.0×10^{-10} uCi/cm^3	1.0×10^{-3} uCi/cm^3
	DU	(2.8×10^{-1} mg/m^3)	(2.8×10^{6} mg/m^3
Unrestricted	U	2.5×10^{-12} uCi/cm^3	3.0×10^{-5} uCi/cm^3
	DU	(7.0×10^{-3} mg/m^3	(8.4×10^{4} mg/m^3

+U refers to natural uranium and DU to depleted uranium (see ** note below)

*Areas where the allowable concentrations are applicable are defined by NRC as:

Restricted Area - any area access to which is controlled by the licensee for purpose of protection of individuals from exposure to radiation and radioactive materials.

Unrestricted Area - any area access to which is not controlled by the licensee for the purpose stated above.

**Concentration levels are given in units of uCi of natural uranium per cm^3 of air or water. Conversion to equivalent units of milligrams of DU per cubic meter (mg/m^3) was obtained by using the specific activity of DU (3.6×10^{-7} Ci/g).

Source: 10 CFR 20, Appendix B (Ref. 2).

1.2 Effects on Air

Potential effects on air quality from dispersion of DU particles may arise from manufacturing, storage, transportation and open air firings (during testing activities and combat). The applicable air quality standards for uranium concentration in the air within and outside licensed facilities are shown in Table A. These NRC standards are maximum allowable concentrations that an individual may be subjected to in an enclosed facility for 40 hours per week or thirteen weeks, and average annual levels for open-air areas outside the facility. These standards can be considered conservative for DU, which is less radioactive than natural uranium. The effects on air quality of manufacturing, transportation and storage of DU material are summarized below.

1.2.1 Transportation

Transportation involving movement of DU materials could conceivably affect the atmosphere, but only in the remote case of an accident that might result in the burning of the DU cargo. Such fires would produce oxides having very short atmospheric lifetimes (Ref. 1).

1.2.2 Storage

Storage of DU rounds in a land-based ammunition magazine may result in slight degradation of air quality, but only in the case of a fire in the magazine which would ignite the DU and release oxides to the atmosphere. These oxides would have short lifetimes (Ref. 1).

1.2.3 Open Air Firing Operations

During open air firing operations (i.e., testing and combat), uranium compounds are released into the atmosphere as a result of the projectile impacting the target. Temporarily suspended compounds produced by the impact eventually settle onto exposed surfaces. The required settling time is dependent upon prevailing meteorological conditions. The overall result is to

temporarily reduce air quality in local areas slightly below normal levels. However, air quality should quickly return to normal as the DU particles would be rapidly dispersed.

Official DoD test ranges are selected on the basis of remoteness. Safety procedures generally require an adequate waiting period following firings (normally five minutes) before personnel are allowed in the test area to preclude the risk of inhaling any ambient DU particles. Ingestion of DU material is limited by requiring appropriate clothing (i.e., gloves, etc.), disallowing eating, drinking or smoking while personnel are in the area, and requiring proper cleansing of hands after leaving the area.

In combat situations which involve widespread use of DU munitions, the potential for inhalation, ingestion or implantation of DU compounds may be locally significant. Ambient DU particles are not significant around the firing gun locations but can be found at the impact point where a small cloud of DU particles is generated upon target impact. Clearly, however, the risks associated with DU are insignificant when compared to the dangers of combat.

A series of radiation monitoring tests were conducted by General Electric during August 1973 to determine radioactivity levels at the gun and the impact area during and after firing PHALANX DU rounds (Ref. 2). Results of the firings are summarized in Table E. the readings were obtained at the target impact point and the immediate area. The alpha counts were obtained from pieces of the round in the immediate area that were not completely burned up or were imbedded in the armor. From these figures, it is seen that gamma radiation was only slightly above background levels after each firing. The

TABLE B

SUMMARY OF RADIATION MONITORING TEST RESULTS (JUNE-AUGUST 1973)

DATE	ACTIVITY	RADIATION LEVELS			LOCATION OF READINGS
		α (counts/min)	β (mr/hr)	γ (mr/hr)	
6/27/73	No firing - background levels were measured	0	0	0.020	Munitions building
		0	0	0.035	Impact area
6/28/73	After first round was fired	0	1.8	0.030	Impact point
		normal background count			Gun
6/28/73	After 10 rounds were fired	0	4.0	0.100	Impact point
7/9/73	After 10 rounds	0	2.1	0.100	Impact point
7/10/73	After 16 rounds	0	3.0	0.100	Impact point
7/11/73	After 13 rounds	150	2.7	0.100	Impact point
7/12/73	After 15 rounds	75	1.2	0.100	Impact point
7/18/73	After 12 rounds	150	1.5	0.100	Impact point
7/19/73	After 2 rounds	0	3.0	0.100	Impact point

Source: Ref. 2

ENCLOSURE (4)

visible increase in radiation was from beta and alpha particles. Air samples taken each day after the completion of firing tests showed only normal background radiation levels (Ref. 3).

Radiation monitoring was also conducted during a series of test firings against an aerial tow target in December 1973. Radiation levels at the target impact points ranged from 0.06 to 1.25 mrem/hr for gamma and beta radiation. Alpha counts per minute ranged from 0 to 242, slightly above the levels encountered in the GE tests, but were still insignificant (Ref. 4).

1.3 Effects on Water

Depleted uranium released to aquatic environments is expected to have a minor impact because of DU's low solubility in water. Potential releases of DU in water may result from DU round testing or combat use. effluents from licensed facilities will be in accordance with 10 CFR 20.

Open air firings of DU penetrators during test and combat activities pose a minor potential for impact on water quality in the area of use. However, DU released to the environment by expended munitions will consist of the relatively insoluble uranium and uranium-oxide compounds. DU released to fresh water environments will probably add less additional radioactivity to its surrounding than DU released to seawater environments because:

- DU released to freshwater would most likely be caused by transportation

accidents involving small shipments of all-up MK149 rounds (with the shielding benefit of the sabot)

. DU corrodes faster in seawater

Nevertheless, the effect on the overall uranium concentration of releases of DU projectiles to the oceans would be negligible compared to the natural background levels found in seawater.* In addition, natural uranium concentrations have been estimated to be 30 to 35 mg/m^3 of uranium in the vicinity of river mouths and 50 to 60 mg/m^3 at the river centers (Ref. 1). (These concentrations exceed the standards in 10 CFR 20.)

Depleted uranium in various aquatic environments will behave much as natural uranium, but with lower solubility and without the more serious consequences of Ra-226 that normally accompany unrefined uranium. Thus, the above characteristics provide conservative measures in comparing DU with most of the reported studies of occurrence, behavior, and effects of natural uranium in aquatic environments.

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*Total uranium background amount for world oceans and seas is estimated at 18,200 metric tons. During 1960-61 period, there were about 910 metric tons of uranium transported by rivers to the ocean in the continental United States (Ref. 1).

1.4 Effects on the Food System

Potential effects on the food system consisting of wildlife, plants and aquatic life may arise from ambient DU particulates generated during testing and combat exercises being inhaled or ingested by animals and deposited on plants. Since most of these activities take place at sea there is minimal impact to plants and wildlife. Furthermore, land test areas are generally located in remote areas. Nevertheless, a discussion of the possible effects on the food system due to exposure or intake of DU is presented in the following paragraphs.

Effects on wildlife occur as a result of their inhalation and ingestion of DU. Inhalation risks are minimal because the concentration of ambient DU particulates in test areas immediately following firing is generally low and decreases rapidly afterwards.

The risks of ingestion by wildlife are also low. Uranium is not effectively transported in the food chain. That is, higher animal forms do not absorb all the uranium existing in the lower animal forms on which they feed. In addition, the effects of animal feeding on naturally occuring quantities of uranium have not been shown to be detrimental. For instance, tests conducted in Russia on animals feeding on uranium-rich land resulted in no visible adverse effects on the animals (Ref. 1). Sheep feeding in the uranium-rich areas accumulated five to eight times as much uranium as those animals feeding in the control area; however, no somatic effects upon the test animals were noted. It has also been estimated that cows would have to ingest

daily, seven grams of natural uranium to reach maximum permissible concentrations. Since depleted uranium is much less of a concern than natural uranium because of its lower radioactivity levels and lack of hazardous Ra-226 and Ra-222 nuclides, the effect on animals of DU ingestion is expected to be less significant than that of natural uranium.

Effects on aquatic life are not expected to be significant, based on the evidence that very low uranium concentrations are found in aquatic life, even in areas of the world where high concentrations of uranium in water are found. Predatory fish possess the least amount of uranium concentration, while most plant-feeding species possess greater amounts (Ref. 1).

Effects on plants may be significant if the soil becomes contaminated with large quantities of DU particles. Experiments have shown that the presence of uranium in soil causes growth of soil micro-organisms and over-stimulation of plant growth with concentrations of 0.002 mg of uranium per one gram of soil (i.e., 0.002 mg/g). Poisoning symptoms on plants have been noted at 0.048 mg/g. These results, however, were obtained from experiments using natural uranium-thorium, which have much higher radioactivity levels than depleted uranium (Ref. 1).

Notwithstanding these effects, the likelihood of a significant release of DU to plants is low since land-based firing tests are generally conducted in sparsely-vegetated, remote areas. As indicated in Section 1.2 and 2.2, cleanup procedures after firing tests are required to minimize the risk of contamination to plants, wildlife and personnel.

2. HOW DU CAN BE RELEASED TO THE ENVIRONMENT

2.1 Storage

Storage of DU rounds is governed by licensing requirements specified in 10 CFR 40 and by the standards of protection from radiation detailed in 10 CFR 20. The DU rounds will be stored at existing Naval Ammunition Depots and aboard Navy ships. The standard M548 ammunition container with capacity of 100 20mm rounds has been recommended for storage. Handling and drop tests on the M548 ammunition container with capacity of 100 20mm rounds has been recommended for storage. Handling and drop tests on the M548 ammunition container holding 100 DU rounds were conducted by the Navy and proved successful (Ref. 5). A packed container with 100 DU rounds was subjected to a low order repetitive shock for two hours with no visible damage to the ammunition. The packed container was also dropped five times on a steel surface from a height of 30 inches, each time with a different container orientation. The container did not open and no visible damage occurred to the DU rounds. Only a slight snagging of the munition belts was observed, which could be corrected by additional belt separators. Also the nylon sabat on the DU round remained intact and in good condition during the drop tests. The tests, therefore, showed that the M548 container provides a satisfactory package for 100 DU rounds, which will survive the rough handling specifications of Naval Ordnance requirements.

Nominally, 24 M548 containers can be stacked on a 40-1/2 x

49-5/8 x 34 in. shipping pallet with an approximate weight (fully loaded) of 2160 pounds (Ref. 6). About 50 pallets can be stored in a 30 by 50 foot earth-covered, igloo-type magazine. Each pallet is marked with appropriate warnings advising personnel of the radioactivity of the shipment, even though radiation monitoring in and around ammo storage areas has shown no radiation above normal background levels. It is estimated that 8000 rounds will be stored on board Navy ships equipped with PHALANX.

Corrosion of DU penetrators in a storage environment is not significant enough to cause performance degradation or safety hazards. Corrosion of bare DU rounds is an important issue since it could result in loss of round weight thus resulting in potential performance degradation. However, various corrosion tests of the DU penetrator (in bare form and as all-up rounds) showed no visible effects under severe environmental conditions (i.e., 85 percent relative humidity and 115°F temperature). Only under extreme conditions (95 percent relative humidity and 160°F) did significant weight loss occur in the bare DU penetrator. No corrosive effects of significance were evident on penetrators assembled into all-up rounds, even under extreme environmental conditions (Ref. 7). Storage tests using a prototype DU penetrator comparable to that used in PHALANX (i.e., DU 8 percent Molybdenum alloy 15mm round) subjected to normal storage exposure conditions for about 10 years showed no signs of corrosion other than the normal oxide film that forms on the penetrator exterior soon after machining (Ref. 1).

Radiation emanating from standard M548 ammunition boxes is well

below recommended maximum limits. In addition, radiation rates for a DU ammunition pallet are the same as for a single box (Ref. 8); hence, radiation levels within a storage magazine are expected to be within safety limits. Therefore, no radioactive or safety hazards are associated with DU round storage activities. Consequently, no significant impact on the environment is expected from DU projectile storage.

2.2 Disposal

As a natural consequence of storage of DU munitions, large quantities of materials containing DU will enventually require disposal. The life of the present complete DU round has been estimated at about ten years. At present, it is assumed that, barring use under wartime conditions, all DU rounds will eventually require disposal. Old munitions will be turned over to a licensed contractor or manufacturer for disposal/rework..

Tab (A) governs disposal procedures for DU waste generated during testing. For land-based testing, a "bullet catcher" shaped as a box with dimensions on the order of 20 x 16 x 12 ft and filled with sand is typically used as a backstop behind targets at which DU ammunition is fired. The DU rounds are accumulated in the catcher, and the sand and the DU rounds are retrieved and disposed at a licensed disposal facility.

2.3 Catastrophic Release Modes

This section investigates the possible impact of catastrophic releases of large quantities of PHALANX DU rounds to the environment. The following release modes are considered:

- Loss of a PHALANX-equipped ship

- Loss of an ammunition ship

- Loss of a land-based ammunition storage magazine

- Accident during DU transportation

- Battle scenario

2.3.1 Loss of a Ship

A ship carrying PHALANX would contain approximately 8000 rounds or an equivalent 0.56 metric tons of DU. Loss of the ship at sea would release an undetectable amount of uranium compared to the natural background amount of uranium in sea water, i.e., 3.34 metric tons of uranium per Km^3 of ocean (Ref. 1). In other words, assuming that the ship releases its rounds in one Km^3 volume of sea water, a concentration equivalent to 17 percent of the normal background level would be released. This amount is negligible when considering that there are a total of approximately 1.3 billion Km^3 of ocean in the world.

2.3.2 Loss of an Ammunition Ship

Loss of an ammunition ship at sea carrying on the order of

100,000 DU rounds would release an equivalent 7 metric tons of uranium. Assuming this quantity is released to one Km^3 of sea water, the local concentration would be comparable to twice the background quantity of uranium in sea water. Thus, the additional contribution to natural background uranium as a result of the release to the ocean would be insignificant when considering there are a total of 1.3 billion Km^3 of ocean in the world.

2.3.3 Loss of an Ammunition Magazine

A typical storage magazine contains from 120,000 to 240,000 DU rounds. This quantity is equivalent to 8 to 17 metric tons of DU. Under the worst possible case, i.e., a fire in the magazine that would ignite the DU, no significant release of DU to the surrounding areas should occur, since the DU ammunition is not a high explosive and the magazine is designed to contain and limit the destructive effects of the material stored inside. The only effect would be a slight local degradation of air quality due to uranium airborne particles produced in the fire and escaping the structure (Ref. 1).

2.3.4 Accident During DU Transportation

An accident involving a truck carrying DU material either in metal derby or all-up round form would be of less magnitude than those accidents considered above (except for loss of a PHALANX equipped ship), since the amount of DU material involved in the accident is much less. For instance, an accident of a truck carrying 24,000 DU rounds (equivalent to about 1.7 metric tons of DU) resulting in a fire would produce oxides that

would cause a slight degradation of the local air quality. Air quality would return to normal levels shortly after the fire subsides, since the uranium oxides generated would have brief atmospheric lifetimes.

2.3.5 Battle Scenario

To assess the environmental impact of a battle scenario, a specific scenario needs to be postulated. For example, a worst case scenario would consist of task force consisting of two aircraft carriers, a cruiser and nine destroyers under attack by a sortie of twelve ASM's. Each ship is equipped with PHALANX and consequently would fire against the missle thre... Under these conditions, a total of 5,000 to 10,000 rounds would be expended according to the ship firing doctrine used. As a consequence, the local air quality would be temporarily degraded due to the minute DU particles generated by the projectiles impacting the missiles. This local degradation should be short in duration since the airborne particles will settle to the water rather quickly. The effect on water quality would be negligible since the total quantity of DU particles released to the sea (on the order of 0.7 metric tons) would amount to about 20 percent of the normal background level of uranium in sea water.

REFERENCES

1. "Medical and Environmental Evaluation of Depleted Uranium Volume I," prepared by the Joint Technical Coordinating Group for Munitions Effectiveness (JTCG/ME) Ad-Hoc Working Goup for Depleted Uranium, April 1974.

2. "Standards for Protection Against Radiation", Title 10 of the Code of Federal Regulations, Part 20, Washington, D.C.

3. Emmons, D.E., "MK149 Mod 0 20mm Discarding Sabot Penetration Test Results", General Electric Co. Armament Systems Department, Report No. GE 73APB534, September 1973.

4. "Radioactivity Levels on PMR Testing on Aerial Target", Internal Navy Memorandum, December 1973.

5. "Evaluation of PHALANX Ammunition, 20mm 100 rounds in MK7 Type Links in M548 Container", Naval Weapons Handling Laboratory, Naval Ammunition Depot Earle, Report No. NWHL Report 7373, 1 June 1973.

6. "Weapons Requirement, Palletizing Fleet Issue Unit Load Cartridge 20mm M50 Series Belted with MK7 or MK14 Links in Container M548", Regulation No. WR-54/187A, 29 January 1971.

7. "Productibility Study of 20mm Cartridge, (DS) MK149 Mod 0", Olin Energy Systems Operations, Final Report December 1974.

8. Internal Navy Memorandum to the PHALANX Project Office on Radiation Dose Rates Associated with DU Penetrators, 25 February 1975.

DEPARTMENT OF THE NAVY
Naval Supply Systems Command
Washington, D.C. 20376

NAVSUPINST 5101.9B
SUP 09H2
8 December 1978

NAVSUP INSTRUCTION 5101.9B

To: All Ships and Stations (less Marine Corps field addressees not having Navy personnel attached)

Subj: Disposition of Radioactive Waste Materials; procedures to

(A) Ref: (a) NAVSHIPSINST 9890.12B; Radioactive Equipment and Material Associated with Naval Nuclear Propulsion Plants, Control and Disposition of

(R) (b) DOD 4160.21-M, Defense Disposal Manual, Chapter IV Paragraph D1H

(R) (c) 10 CFR 19-71, Nuclear Regulatory Commission

(R) (d) 49 CFR 171-179, Department of Transportation

(e) NAVMED P-5055, Radiation Health Protection Manual

(f) MIL-STD-1458, Radioactive Materials; Marking and Labeling of Items, Packages and Shipping Containers for Identification in Use, Storage, and Transportation

(A) (g) NAVSUP PUB 505, Preparation of Hazardous Materials for Military Air Shipment

(R) (h) NAVSUPINST 4000.34A, Radioactive Commodities in the DoD Supply System

(i) NAVELEXINST 9673.5D

1. Purpose. [illegible] Naval Supply [illegible] and Oakland as Navy contracting points [illegible] [illegible] material from Naval [illegible]

[illegible]

3. Background. [illegible]

[illegible]

Nuclear Regulatory Commission (NRC) for possessing, storing, issuing, transferring, packaging for transport and disposing of radioactive material licensed by the NRC. Reference (d) establishes procedures for packaging, marking, and shipment of radioactive material either licensed by NRC or nonlicensed as classified in subparagraph 5 a. below. In reference (e), Bureau of Medicine and Surgery (BUMED) establishes radiological health regulations for the Navy and provides policy and procedures for storing, handling and disposition of radioactive material. Paragraph 7-5 of reference (e) discusses the requirement that radioactive material be disposed of by organizations licensed to perform this type of work by the NRC or in Agreement State. Reference (f) established procedures to be followed by supply activities in the marking of radioactive commodities in the supply system. Reference (g) contains procedures and requirements for the packaging and handling of radioactive material for transportation by military aircraft. (A)

4. Navy Radioactive Waste Disposal Contracting Points. NSC Norfolk and NSC Oakland are designated as the Navy's disposal contracting points for radioactive [illegible] material except for nuclear waste as indicated in paragraph 1 above. These activities will contract [illegible] firms licensed by the NRC or an Agreement State and the firms will perform the actual [illegible] Arrangements will be made [illegible] picked up at a CONUS [illegible] in the case of transshipments [illegible] shipment from the waste [illegible] selected on the basis [illegible] contracting activity. NSC [illegible] (R) (A)

[illegible] (reference (e)).

5. [illegible] Requirements.

a. [illegible] of Radioactive Material.

(1) Licensed Material. This includes all material [illegible] specific NRC license.

(2) Nonlicensed Material. This includes all [illegible] NRC licensing or [illegible] considered (R)

TAB (A)

ENCLOSURE (4)

in reference (c). Nonlicensed material may or may not be controlled by an inventory manager.

b. Procedures

R) (1) **Safeguards by Holding Activities.** Waste-generating activities must package all waste in a Department of Transportation (DOT) approved container prior to requesting disposition instructions. The items must be properly labeled and kept in restricted areas posted in accordance with Part 20 of reference (c) and references (e) and (h).

A) (2) **Nuclear Propulsion Waste.** Naval activities should follow the requirements of NAVSHIPS 389-0153, "Radiological Controls" or NAVSHIPS 389-0288, "Radiological Controls for Shipyards," for the disposition of radioactivity associated with naval nuclear propulsion plants in accordance with reference (c).

R (3) **Radioactive Test Sources for Checking Radiac Equipment.** Disposal procedures for radioactive test sources provided for checking radiac equipment are delineated in reference (i).

R (4) **Licensed Material.** The generating activity [illegible] licensed radioactive material for disposition [illegible] with instructions for the material issued by the cognizant command office or controlling inventory manager. Subsequent to receipt of authority [illegible] of licensed material from the appropriate inventory control point, request will be made to NSC Norfolk (Code 105.1) or NSC Oakland (Code [illegible]) for shipping instructions.

(5) **Nonlicensed Material** [illegible] NRC licensing requirements [illegible] by a specific or general authorization [illegible]

[illegible] licensing requirements [illegible] is not subject to control by the cognizant inventory manager prior to initiation of a request for disposal to NSC Norfolk (Code 105.1) or NSC Oakland (Code 300). [illegible] material, disposition and/or authority for disposal will be requested of the appropriate inventory manager.

(b) Provided that no authority is required (R and/or upon receipt of authority to dispose of the material as radioactive waste, disposal instructions will be requested from NSC Norfolk or NSC Oakland, whichever is closer.

(c) Activities will not request disposition instructions, under this procedure, for items that are repairable and should be reported to the cognizant inventory manager.

(6) **Government Furnished Licensed or Nonlicensed Material**

(a) In the case of radioactive waste generations in contractors' plants resulting from use of Government furnished material, the responsible contract administration officer or other appropriate party will request disposition instructions from the systems command or office that furnished or directed the supply of such material under terms of the applicable contract.

(b) On receipt of authority and funds to dispose of the waste material, a request in accordance with this instruction will be forwarded to NSC Norfolk (Code 105.1) or NSC Oakland (Code 300), whichever [illegible] disposition.

(c) Under [illegible] will requests [illegible] of radioactive [illegible] NSC's Norfolk [illegible]

(7) Generating Activity Requests. In addition (R [illegible] subparagraph 5b(9) be- [illegible] will in- [illegible]

[illegible] (R

[illegible] (R

[illegible] specifically (R [illegible]

(d) Radioactive element (include mass number and whether liquid, gas or solid).

(e) Measurement of radioactive element in curies, millicuries or microcuries.

(f) Number and type of containers in shipment, how packaged, weights and cube—this is a mandatory requirement.

(g) Radiation readings of each container in mrem/hr at surface of container(s) and at 3 feet from surface. Readings should be taken subsequent to containerizing for shipment.

(h) Location where material will be available for pickup.

(i) If it is desired that casks furnished for shipments be returned to the generating activity, requests should indicate this.

(j) As applicable, a statement that the material is not subject to control by an inventory manager or that the material is subject to control and authorization for disposal has been granted by the cognizant inventory manager in accordance with (indicate applicable instruction for material).

(8) **Disposition of Radioactive Waste.** Radioactive waste, including contaminated items which will not be decontaminated for use or reuse, will be moved by the following procedure:

(a) Generating activities will await disposition instructions from the cognizant Naval Supply [illegible]

(b) Upon receipt of disposition instructions from NSC Norfolk or NSC Oakland, generating [illegible] ship material to the designated [illegible] [illegible] material [illegible] and (g), as applicable.

(c) [illegible] instructions from the [illegible] Supply Center will normally advise the [illegible] radioactive material [illegible] [illegible] burial site, or in some instances, hold the material for pickup by a designated licensed contractor for disposition. Especial attention is directed to those instructions which will appear in the contract/order to notify the burial site immediately of the shipment by forwarding a copy of the covering bill of lading.

(d) As an exception to 5b(8)(c) above, transshipments of material involving transportation from overseas by either military or contract aircraft or by ocean vessels to a CONUS base should be handled as follows: (R

(1) The overseas generating activity shall apply to the closest disposal contracting point, NSC Norfolk or NSC Oakland, for shipping instructions, providing advance shipping data on proposed schedule for disposal of material, estimated volume in cubic feet, and other applicable information required by paragraph 5.b.(7) above. (R

(2) Shipping instructions from the cognizant Naval Supply Center shall include the provision for a licensed contractor to pick up the radioactive material upon arrival at the CONUS port of entry for transportation to the closest authorized burial site. (R

(e) Military vehicles transporting any quantity of radioactive material packages bearing a "RADIOACTIVE yellow-III" label must display the appropriate placard required under reference (d), Section 177.823(a). (R

(9) **Funding.** Financing for the disposition of this material will be borne by the waste-generating activities including the operating forces. The waste-generating activities will submit funded requisitions [illegible] station, so that the Naval Supply [illegible] data on the contract or order. [illegible] contractor will then bill the generating [illegible]. A MILSTRIP document number shall be entered on the requisition. (R

V. T. EDSALL
Vice Commander

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DEPARTMENT OF THE NAVY
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IN REPLY REFER TO
8128
Ser 6445/394

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From: Commander, Naval Sea Systems Command
Washington, D.C. 20362, Attn: SEA-644
To: Director, Nuclear Material Safety and Safeguards,
US Nuclear Regulatory Commission,
Washington, D.C. 20555
VIA: Director, Naval Sea Systems Command Detachment,
Radiological Affairs Support Office (RASO),
Yorktown, VA 23691-5000

Subj: SOURCE MATERIAL LICENSE SUB-1190

Ref: (a) MTG btwn Mr. J. Taschner, NAVSEA 644B, Mr. K. Rimm, NAVSEA-6445 and Mr. J. Hickey, NRC Licensing Branch, of 12 Dec 84
(b) NAVSEA Memo, 8128, Ser 6445/386 of 12 Dec 84, "10 CFR 20.203(e) Posting Exemption for Navy Depleted Uranium (DU) munition in Naval Warships"
(c) Phoncon btwn Mr. B. Carrico, NRC Licensing Branch and Mr. K. Rimm, NAVSEA 6445, of 13 Dec 84

Encl: (1) Ingalls Sign No. 5246

1. As discussed during reference (a) and documented by reference (b), request that Source Material License SUB-1190 be amended to authorize a waiver from the "Caution Radioactive Material" posting requirement specified in 10 CFR 20.203(e) for depleted uranium (DU) munitions in Naval warship magazines. The Navy will post Ingalls sign No.5246 provided as enclosure (1) or equivalent instead of the "Caution Radiological Material" sign. Our waiver request applys to Naval warship magazines and does not apply to shore based magazines which will continue to be posted in accordance with 10 CFR 20.203(e). The Navy will continue to ensure that personnel who enter Naval DU munition magazines are instructed in the health protection problems associated with handling DU munitions as required by 10 CFR 19.12.

2. The following supplemental information is provided as requested during reference c. The Navy does not label 20 mm, DU ammunition containers with "Caution or Danger Radioactive Materials" signs. Labeling is not required pursuant to 10 CFR 20.203 f(3)(V) and (VI). During transportation, labels are not required pursuant to 49 CFR 173.422 based upon an average U-235 content per container of 13.9 gms. (100 rounds per can, 70 gms of DU per round, .1986% U-235 by weight). When not being transported, DU ammunition containers are stowed in locked Naval ammunition magazines which are located at guarded Naval Stations and in Naval warships. Access to Naval ammunition magazines is limited to authorized personnel. Each 20 mm, DU ammunition container is marked with Naval Ammunition Logistics Code (NALC), Mark (MK) and Modification (MOD), Personnel with magazine access are aware which NALC, MK and MOD represent 20 mm, DU cartridges.

Dupe ~~8508120766~~

Subj: SOURCE MATERIAL LICENSE SUB-1190

3. Point of contact at Naval Sea Systems Command concerning this matter is Mr. Kip Rimm (202) 692-1223/1252.

John C. Taschner

John C. Taschner
By direction

SAFETY PRECAUTIONS

CIWS MK 15 AMMUNITION HANDLING

1. THE CARTRIDGE MK 149 MOD 0 AUTHORIZED FOR USE IN CIWS IS CLASSIFIED AS CLASS C EXPLOSIVE. THE PRIMER AND PROPELLANT ARE THE ONLY COMPONENTS HAVING POTENTIAL EXPLOSIVE HAZARD. THIS AMMUNITION MUST BE HANDLED IN ACCORDANCE WITH OP 4. THE CARTRIDGE CONTAINS AN ELECTRIC PRIMER AND IS THEREFORE SUBJECT TO RADIATION HAZARD (RADHAZ). ALL HF TRANSMITTERS (2-32 MHZ) AND B-BAND RADARS (200-450 MHZ) SHOULD BE SECURED WHEN IT IS NECESSARY TO HANDLE UNLINKED AMMUNITION, SUCH AS WHEN CLEANING A GUN JAM.

2. AMMUNITION ON DECK, OUT OF ITS APPROVED CONTAINER AND NOT IN THE GUN SYSTEM, SHOULD ALWAYS BE HANDLED IN THE APPROVED MK 7 MOD 1 RADHAZ LINKS. ANY LOOSE AMMUNITION THAT IS EXPOSED TO RF FIELDS SHOULD BE DISPOSED OF IMMEDIATELY. ANY CONDUCTING OBJECT IN CONTACT WITH THE PRIMER, INCLUDING PERSONNEL TOUCHING THE PRIMER, IN AN RF FIELD CAN CAUSE THE PRIMER TO DETONATE. EXTREME CAUTION SHOULD BE EXERCISED WHEN IT IS NECESSARY TO HANDLE LOOSE AMMUNITION.

3. THE CARTRIDGE MK 149 MOD 0 CONTAINS A SUBCALIBER HEAVY-METAL PENETRATOR OF DEPLETED URANIUM (DU). THE RESIDUAL RADIATION LEVEL OF THE DU, PRIMARILY ALPHA PARTICLES, IS SO LOW AS TO PRESENT NO HAZARDS TO PERSONNEL. THE ONLY PERSONNEL HAZARD FROM DU IS ITS TOXICITY, THAT IS, THE POSSIBILITY OF HEAVY METAL POISONING IF ANY DU IS INGESTED INTO THE BODY. IN ITS UNFIRED STATE, THE DU PENETRATOR IS ENCASED IN A PLASTIC SABOT THAT EFFECTIVELY PROTECTS OPERATING PERSONNEL FROM CONTACT WITH THE HEAVY METAL. HOWEVER, IF A CARTRIDGE SHOULD BECOME DAMAGED AND EXPOSE THE DU DURING HANDLING, OR IF DEBRIS FROM TARGETS THAT HAVE SUSTAINED HITS IS RECOVERED BY SHIPBOARD PERSONNEL, POSSIBLE HEAVY METAL POISONING MAY RESULT. LOOSE DU PENETRATORS AND TARGET DEBRIS SHOULD BE HANDLED ONLY WITH HEAVY GLOVES. SPECIAL CARE SHOULD BE EXERCISED IF ANY PART OF THE OBJECT BEING HANDLED CONTAINS JAGGED METAL THAT CAN EASILY TEAR THROUGH GLOVES AND OTHER CLOTHING TO DAMAGE THE SKIN. HANDS SHOULD BE WASHED THOROUGHLY AFTER ANY HANDLING OPERATION, AND ANY CUTS OR BRUISES SUSTAINED DURING THE OPERATION SHOULD BE REPORTED IMMEDIATELY TO THE MEDICAL OFFICER.

INGALLS NO. 5246

ENCLOSURE(1)