

## DEPARTMENT OF THE NAVY HEADQUARTERS UNITED STATES MARINE CORPS 3000 MARINE CORPS PENTAGON WASHINGTON DC 20350-3000

MCO 5104.2 PMM-152 15 Apr 2019

## MARINE CORPS ORDER 5104.2

From: Commandant of the Marine Corps

- To: Distribution List
- Subj: MARINE CORPS RADIATION SAFETY PROGRAM FOR DEPLETED URANIUM AMMUNITION
- Ref: (a) Naval Radioactive Material Permit 45-67854-L1NP
  - (b) MCO 5104.3B
    - (c) NAVSEA S0420-AA-RAD-010
    - (d) CFR Title 10, "Energy"
    - (e) CFR Title 49, "Transportation"
    - (f) OPNAVINST 6470.3B
    - (g) NAVMED P-5055
    - (h) MCO 8010.13
    - (i) NUREG-1556, Volume 12, "Consolidated Guidance About Materials Licenses: Program-Specific Guidance About Possession Licenses for Manufacturing and Distribution," May, 2018
    - (j) NAVSEA OP-4
    - (k) NAVSEA OP-5
    - (1) NAVSEA SW020-AC-SAF-010
    - (m) DoD 4715.6-R, "Low Level Radioactive Waste Disposal Program,"
      January 17, 2001
    - (n) SECNAV M-5210.1
    - (o) MCO 5530.14A
    - (p) DOT Special Permit SP-9649
    - (q) SECNAV Notice 5210
    - (r) MCO 5210.11F
    - (s) 5 U.S.C. 552a
    - (t) SECNAVINST 5211.5E
    - (u) NAVSEA SE700-AP-URM-010
    - (v) NAVSEA SE700-AA-MAN-100/RADIAC
    - (w) NAVSEA EE700-AD-MMO-010
    - (x) NAVSEA EE730-AB-MMO-010
    - (y) USDOT Emergency Response Guidebook
    - (z) NUREG-0980 Vol. 1, Nuclear Regulatory Legislation
    - (aa) NRC Regulatory Guides Occupational Health (Division 8)
- Encl: (1) Marine Corps Radiological Affairs Support Program (RASP) for Depleted Uranium (DU) Ammunition

1. <u>Situation</u>. This Order is in accordance with references (a) through (aa). The Navy Radiation Safety Committee, located at the Office of the Chief of Naval Operations, has delegated management of reference (a) to Commander, Marine Corps Systems Command (COMMARCORSYSCOM), under Navy Master Materials License No. 45-23645-01NA. Reference (a) authorizes Marine Corps and Navy activities worldwide, both ashore and afloat, to possess and store DU ammunition for war reserves under this single Naval Radioactive Material Permit held by COMMARCORSYSCOM.

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2. <u>Mission</u>. This Order provides policy and procedural guidance to implement the Marine Corps Radiological Affairs Support Program (RASP) for DU ammunition. The program ensures radiation safety regulatory compliance in accordance with references (a) through (i). Policy, procedural guidance and specific command responsibilities are contained in enclosure (1).

## 3. Execution

# a. Commander's Intent and Concept of Operations

(1) <u>Commander's Intent</u>. To ensure all Commands that have management or inventory control and accountability responsibilities for DU ammunition and/or are in possession of DU ammunition, comply with this Order as a condition of reference (a).

## (2) Concept of Operations

(a) The provisions set forth in this Order identify specific command responsibilities and establishes program requirements to ensure compliance with the U.S. Nuclear Regulatory Commission (NRC), Application for Materials License (NRC Form 313), the approved application for reference (a).

(b) This Order is applicable worldwide for Marine Corps commands and, as a condition of reference (a), provides procedural guidance for Navy commands in possession of DU ammunition listed in reference (a).

(c) This Order applies only to DU ammunition identified by Department of Defense Identification Codes (DODIC) in reference (a).

b. <u>Subordinate Element Mission</u>. Commands in possession of DU ammunition shall comply with reference (a) and enclosure (1).

#### 4. Administration and Logistics

a. In case of conflicting policies or regulations, the most stringent policy/regulation shall apply. Conflicting policies shall be reported to COMMARCORSYSCOM.

b. Recommendations concerning the contents of this Order may be forwarded to COMMARCORSYSCOM, 2200 Lester Street, Quantico, Virginia 22134-6050 (Attn: Program Manager (PM) Ammo) via the appropriate chain of command.

c. Revisions to this Order must be submitted via the chain of command and forwarded to Naval Sea Systems Command Detachment, Radiological Affairs Support Office (NAVSEA DET RASO) requesting an amendment to reference (a).

d. Policies and procedures for life-cycle management of records created as a result of this Order, regardless of media, will be in accordance with references (c) and (i).

e. <u>Records Management</u>. Records created as a result of this Order shall be managed according to National Archives and Records Administration approved dispositions per references (q) and (n) to ensure proper maintenance, use, accessibility and preservation, regardless of format or medium. Refer to reference (r) for Marine Corps records management policy and procedures. f. <u>Privacy Act.</u> Any misuse or unauthorized disclosure of Personally Identifiable Information (PII) may result in both civil and criminal penalties. The Department of the Navy (DON) recognizes that the privacy of an individual is a personal and fundamental right that shall be respected and protected. The DON's need to collect, use, maintain, or disseminate PII about individuals for purposes of discharging its statutory responsibilities will be balanced against the individuals' right to be protected against unwarranted invasion of privacy. All collection, use, maintenance, or dissemination of PII will be in accordance with the Privacy Act of 1974, as amended (reference (s)) and implemented per reference (t).

## 5. Command and Signal

- a. Command. This Order is applicable to the Marine Corps Total Force.
- b. Signal. This Order is effective the date signed.

A. J. PASAGIAN By direction

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Marine Corps Radiological Affairs Support Program (RASP) for Depleted Uranium (DU) Ammunition

## Chapter 1

## Roles and Responsibilities

#### 1. Commander, Marine Corps Systems Command (COMMARCORSYSCOM) shall:

a. Applicable to this Order and reference (a), perform duties and responsibilities specified in reference (c), Section 1.5.2.1.

b. Assign, in writing, a qualified DU ammunition RSO. The Marine Corps Systems Command (MARCORSYSCOM) RSO shall:

(1) Perform RSO duties and responsibilities that are specified in this Order and reference (c), Section 1.5.2.2.

(2) Submit an annual inventory of DU ammunition, authorized by reference (a), to NAVSEA DET RASO. This shall be done by 31 January of each year and it will account for all DU ammunition authorized by reference (a) that was in the possession of Marine Corps and Navy activities on 31 December of the preceding year.

(3) Perform a RASP audit of reference (a) requirements every six months in accordance with chapter (2) of this Order.

(4) Provide technical assistance pertaining to the radiation safety requirements associated with this Order and reference (a).

(5) Where Marine Corps DU assets are reported as located at, or in the possession of the U.S. Army, the RSO will verify that those assets have been transferred to their respective licenses and will request associated transfer documents.

(6) Ensure the conduct of on-site audits by RIs at those Marine Corps and Navy activities that possess and store DU ammunition.

(a) RSO audits will be scheduled such that at least one DU ammunition storage location within the Continental United States (CONUS) will be evaluated every six months on a rotating basis unless no such locations exist. Audit schedules will be forwarded, as necessary, to Commandant of the Marine Corps Safety Division (CMC-SD) Senior Health Physicist.

(b) If DU ammunition is not possessed and stored by Marine Corps or Navy activities outside of U.S. Army storage areas, no audits are required.

(c) No audits will be conducted on U.S. Naval ships underway.

(7) Provide DU ammunition disposition instructions to Naval and Marine Corps commands as required or as requested.

(8) Ensure assigned Item Managers responsible for logistics of specific DU ammunition types, implements and enforces the requirements of reference (a), to include the specific conditions and limitations identified. (9) Maintain a current list of RIs for DU ammunition storage locations.

(10) Maintain a reconciliation of DU ammunition inventory expended, transfers to other services (Army or Air Force), receipts from other services (Army or Air Force), disposal, or losses (unaccounted for rounds). Ensure the reconciliation includes appropriate information and documentation to account for changes to specific item inventory numbers from the previous inventory.

(11) Maintain current inventory records for DU ammunition items under Marine Corps possession, for reporting as required of references (b),(c), and (h).

(12) Prior to transfer of Marine Corps DU assets to U.S. Army or U.S. Air Force commands, ensure those commands are authorized to receive the DU assets and that they will be transferred to their respective NRC licenses upon their receipt; obtain all associated receipt documents from the affected U.S. Army or U.S. Air Force command.

c. Assign, in writing, a qualified DU ammunition Assistant Radiation Safety Officer (ARSO) to assist the RSO and perform RSO duties and responsibilities in the absence of the RSO.

2. <u>Commanders, Commanding Officers (CO) and Officers-in-Charge (OIC) of</u> <u>Marine Corps and Navy Commands (Ashore and Afloat) that possess Marine Corps</u> Depleted Uranium (DU) ammunition shall:

a. Comply with the requirements of references (c) and (f).

b. Ensure that measures are established for controlling ionizing radiation sources so that personnel radiation exposures are As Low As Reasonably Achievable (ALARA) and no greater than the limits established in reference (c).

c. Assign, in writing, a qualified DU ammunition Responsible Individual (RI). The RI will act as the command's liaison with the MARCORSYSCOM RSO with respect to DU ammunition in the command's possession. The appointment letter shall specify the following:

(1) The RI will have direct access to the Commander, CO, or OIC on matters dealing with DU safety and compliance.

(2) The RI has independent authority to stop any DU ammunition storage and handling operation the RI considers unsafe.

d. Notify and provide a copy of the appointment letter to the MARCORSYSCOM RSO, when an RI is appointed or changed. This can be submitted via email, Naval message, or fax. The following information is required:

- (1) RI name
- (2) Command Name and unit identification code
- (3) RI rank or position

(4) Command mailing address

(5) RI Non-Secure Internet Protocol Router Network (SIPRNET) (NIPR) email address

- (6) RI SIPRNET email address
- (7) Command phone number
- (8) Command fax number
- (9) CO's name
- (10) CO's NIPR email address
- (11) Plain language address for Naval messaging
- (12) The Command's Immediate Superior in Command

e. Notify the MARCORSYSCOM RSO, upon discovery, any violation of reference (a), this Order, or any radiological incident defined in Chapter 8. The MARCORSYSCOM RSO will be responsible for notification of NAVSEA DET RASO per reference (c), Section 2.27. The term "incident" will be used collectively to refer to all these events. The MARCORSYSCOM RSO will also notify the CMC-SD Health Physicist in the event of any incidents as defined in Chapter 8.

f. Provide oversight of the RI. Ensure the RI has been provided sufficient time and authority to fulfill his or her duties and responsibilities so that the command's DU is effectively managed and stored in a safe manner.

g. Assign an investigating officer to conduct a Judge Advocate General (JAG) Manual investigation, in the event that DU ammunition under command control is lost or unaccounted for.

h. Maintain a current inventory for DU ammunition items that are under your charge, for reporting as required by references (b), (c), and (h).

i. Maintain current copies of references (b), (c), applicable technical manuals, Department of Defense (DoD) and Naval/Marine Corps instructions/orders, and Ammunition Information Notices (AIN) related to DU ammunition.

j. Possess or have access to the types of radiation and contamination survey meters specified in Chapter 3.

3. <u>Command Assigned Responsible Individual (RI) located at Marine Corps and</u> <u>Navy Commands (Ashore and Afloat) that Possess Depleted Uranium (DU)</u> Ammunition shall:

NOTE: It is recommended that the command's Ammunition/Ordnance Officer or his/her subordinate be assigned the duties of an RI under this Order.

a. Complete training via lectures, demonstrations, video, or self-study courses provided by or approved by the MARCORSYSCOM RSO. The RI shall perform all radiation and contamination surveys required of this Order, with exception to transportation DU ammunition package surveys, unless otherwise directed by a command-appointed Transportation Officer.

b. Ensure that all DU operations within your area of responsibility are conducted in compliance with the provisions of this Order and references (b) and (c).

c. Ensure all personnel assigned first-time duties in the handling and storage of DU ammunition, have received training identified in reference (a), as provided by or approved by the MARCORSYSCOM RSO. This training shall also include any special precautions and instructions that pertain to ammunition and explosives safety. Training shall be documented per reference (c), Section 2.26.5, and copies provided to the MARCORSYSCOM RSO.

d. Maintain a current copy of reference (a) and this Order.

e. Ensure the Command only possesses and conducts those operations that are authorized by reference (a).

f. Address the radiological safety requirements and radiological aspects of DU munitions in consultation with the MARCORSYSCOM RSO identified in reference (a).

g. Perform a semi-annual physical inventory of DU ammunition that is in the possession of your command per the requirements of Chapter 4.

h. Ensure reconciliation of the DU ammunition inventory is performed using authorized ammunition and explosives accountability programs to track item use, transfers, receipts, disposal, or losses. Ensure the reconciliation includes appropriate information and documentation to account for changes to specific item inventory numbers from the previous inventory.

i. Maintain a current inventory of DU ammunition and ensure that all items are secured against loss, unauthorized use, or unauthorized disposal.

j. Ensure access to DU ammunition storage locations are restricted only to personnel authorized by the command.

k. Ensure the chain of command receives notification of any transfer, receipt, use, loss, or disposal of DU ammunition.

1. Ensure that the Command maintains current copies of 10 Code of Federal Regulations (CFR) (Parts 19, 20, 21, 40, and 71), 49 CFR (Parts 171-180), and references (c) and (g). Internet access to these regulations is acceptable.

m. For specific DU ammunition types possessed by the command and authorized by reference (a), ensure the command has (or has access to) applicable DoD directives, technical manuals, Naval/Marine Corps instructions/orders, and ammunition AIN related to DU ammunition.

n. Promptly report to the chain-of-command and the MARCORSYSCOM RSO (commercial 703-432-8784, DSN 378-8784) any violation of reference (a), this Order or any radiological incident as defined in Chapter 8.

o. Perform a RASP audit of reference (a) every six months per Chapter 2 of this Order.

p. Perform radiation and contamination surveys per Chapters (3), (10), and (14) of this Order.

q. The command-appointed RI shall provide a list of DU ammunition, by facility and location, to appropriate command security and fire departments at least annually or when changes occur and annually thereafter unless there is no current DU in inventory.

r. Be able to respond within normal commuting time (<2 hours) if offsite when RASP operations associated with DU ammunition are being performed. The RI does not have to be physically present when RASP operations are being performed.

# 4. Personnel Assigned the Duties of Handling or Storing Depleted Uranium (DU) Ammunition shall:

a. Obey posted, verbal, and written command instructions.

b. Promptly report, via the chain-of-command and the RI, any violation of reference (a), this Order, or any radiological incident as defined in Chapter 8.

c. Avoid unnecessary exposure and use the concepts of time, distance, and shielding when working in the presence of DU ammunition to maintain exposure ALARA.

d. Receive training as provided by or approved by the MARCORSYSCOM RSO, and administered by the RI, prior to first-time duty assignment in the handling and storage of DU ammunition. This training shall also include any special precautions and instructions that pertain to ammunition and explosives safety.

5. <u>Process to ensure that personnel will be aware of their responsibilities</u>. Reference (a) and the latest revision to this Order instruction will be transmitted to the above listed RIs.

## Audit Program

1. Appendix (A) provides the RASP an audit, known as the Radiological Deficiency Report (RDR) program for reference (a), and provides for a required audit plan. The MARCORSYSCOM Program Office for Ammunition (PM Ammo) RSO or Assistant RSO shall conduct a RASP audit every six months for compliance with the requirements and condition specified by reference (a). The audit checklist is provided as Appendix (B). The audit checklist shall be documented, command reviewed, and maintained per Appendix (A).

2. The audit checklist provided in Appendix (C) shall be provided by the MARCORSYSCOM RSO to RIs located at specific Naval or Marine Corps commands that are in physical possession of DU ammunition. These RIs will conduct internal audits every six months for DU ammunition they have in their possession and to forward a copy of the completed audit to the MARCORSYSCOM RSO. The MARCORSYSCOM PM Ammo RSO will use these audits in completing his RASP audit required by reference (c), Section 2.9.1.5.

3. The MARCORSYSCOM RSO shall conduct an Annual Program Review (APR). The APR shall include all applicable elements specified in reference (c), Section 2.10.

4. Deficiencies and program improvement items discovered during the APR and not previously identified shall be entered into the MARCORSYSCOM RDR program per Appendix (A).

## Survey Instrument Types and Calibration

1. <u>IM-231 (series) RADIAC</u>. The IM-231 is an appropriate instrument for measuring radiation exposure rates associated with DU ammunition. The IM-231 is an ionization chamber type instrument that is gas-filled (air) and has a range of zero mRem/hr to 5,000 mRem/hr for beta and gamma radiation, with an energy response of +/- 10% at 0.038-1.3 MeV for Cs-137, and is field portable. Calibration of this survey instrument will be performed by the Navy RADIAC Calibration Lab. This instrument is on a twelve-month calibration frequency as specified by NAVSEA SE700-AA-MAN-100/RADIAC, Chapter 4, Section 4.2.1 and Appendix C, Table C-4. The IM-231 shall be response checked in accordance with SE700-AP-URM-010, "Technical Manual, User's Reference, Radiation Source Kit, Multifunction (MFR Source Kit) MX-12XXX/S Series."

2. <u>AN/PDQ-1 RADIAC Set (IM-265/PDQ RADIAC meter with internal detector)</u>. The AN/PDQ-1 can be used if an IM-231 is not available for measuring radiation exposure rates associated with DU ammunition. The AN/PDQ-1 RADIAC Set is field portable and has a range of 0.01 mRem/hr to 1,000 Rem/hr for gamma radiation, with an energy response of +/- 10% at 0.662-1.3 MeV for cobalt-60 and cesium-137. Calibration of this survey instrument will be performed by the Navy RADIAC Calibration Lab. This instrument is on a 12 month calibration frequency as specified by NAVSEA SE700-AA-MAN-100/RADIAC, Chapter 4 and reference (g). The AN/PDQ-1 RADIAC Set shall be response checked in accordance with SE700-AP-URM-010, "Technical Manual, User's Reference, Radiation Source Kit, Multifunction (MFR Source Kit) MX-12XXX/S Series."

3. AN/PDQ-4 RADIAC (IM-265/PDQ RADIAC meter equipped with a DT-685/PDQ and DT-304 detector set). The AN/PDQ-4 can be used in lieu of the AN/PDQ-5 for detection and measurement of contamination associated with DU ammunition. The AN/PDQ-4 RADIAC Set has a range of zero Counts Per Minute (CPM) to 50,000 CPM, with sensitivities to beta (> 40 keV) and gamma radiation and is field portable. This instrument is appropriate for the monitoring and detection of radiological contamination from DU ammunition. Calibration of this survey instrument will be performed by the Navy RADIAC Calibration Lab. This instrument is on a 12 month calibration frequency as specified by reference (g) and Chapter 4 of reference (u). Appendix (D) of this Order provides a technical basis for use of 0.10 as the detector efficiency for the AN/PDQ-4 RADIAC Set for reference (a) NRMP materials. The AN/PDQ-4 RADIAC Set shall be response checked in accordance with reference (u), "Technical Manual, User's Reference, Radiation Source Kit, Multifunction (MFR Source Kit) MX-12XXX/S Series."

4. <u>Radioactivity Detection, Indication and Computation (RADIAC) Procurement</u>. In accordance with reference (c), RASP approved RADIAC instruments are available from the NAVSEA RADIAC Program Office. Reference (v) lists Navy RADIAC Calibration Laboratories by region including their points of contact.

5. <u>Technical Manuals</u>. Reference (w), "Technical Manual Operation, Instructions Organization Maintenance Multifunction RADIAC (MFR) Sets and Ancillary Probes/Interfaces" and reference (x), "Technical Manual Operation and Maintenance Instruction Organizational and Intermediate Maintenance" provide additional instruction in the use and maintenance of the specified RADIAC equipment.

6. <u>Records</u>. Radiation detection instruments inventory, calibration, and response check records shall be maintained for three years.

## Material Receipt and Accountability Procedures

1. <u>Data Transmission</u>. Transmission or storage of any DU ammunition data or inventory information shall be accomplished through the required means for the level of security classification assigned to it (e.g., encrypted messaging for unclassified data transfer, SIPRNET for classified data transfer, a security safe or container for classified data storage that meets all applicable security regulations).

2. <u>Inventory Management</u>. Commands in possession of DU ammunition shall physically inventory DU ammunition assets semi-annually. MARCORSYSCOM RSO will monitor the active inventory of DU ammunition that is in the possession of the Marine Corps. This will be done by receiving inventory data in the form of electronic data or computer printouts from MARCORSYSCOM, of which will provide inventory and transaction history data. The MARCORSYSCOM RSO will provide NAVSEA DET RASO an annual inventory of DU ammunition prior to 31 December. Annual inventory data for each Marine Corps command will be maintained indefinitely.

a. <u>Receipt Processing</u>. All receipt processing is performed by the responsible reporting activity and monitored by MARCORSYSCOM PM Ammo. This inventory control point maintains the records of transaction history data for all reporting activities. Annual transaction history data (receipt and transfer) for each Marine Corps command will be maintained by COMMARCORSYSCOM indefinitely.

b. <u>Ordnance Information System-Marine Corps (OIS-MC)</u>. OIS-MC is used to download receipt, transfer, and inventory data. Army assets that are in the possession of Marine Corps and Navy activities shall be reported by the Marine Corps/Navy RI to the MARCORSYSCOM RSO and be reconciled with inventory data provided in OIS-MC from MARCORSYSCOM PM Ammo.

c. Commands in possession of DU ammunition for storage will provide unclassified inventory data (by facility and location) to the MARCORSYSCOM RSO and to their local security and fire department personnel. This shall be done on initial receipt, when changes occur and on an annual basis.

d. Unclassified inventory data shall be reported by the MARCORSYSCOM RSO to NAVSEA DET RASO by 31 January of each year. These data points are captured and recorded for each DODIC that is assigned to a specific DU ammunition round. The inventory information that is captured from MARCORSYSCOM PM Ammo shall be assembled to include the following information:

(1) DODIC.

(2) Radionuclide: U-238.

(3) Description: "Depleted Uranium (DU) alloy penetrators used in ammunition."

(4) Total Mass (kg); determined from the mass given for a specific DODIC (ammunition type); number of rounds X mass (kg)/round.

(5) Total uCi; determined from the specific activity of DU (3.36 x  $10^2$  uCi/kg) x total mass (kg).

(6) Date of the inventory data.

(7) Quantity of DU rounds (for each DODIC line item).

(8) Manufacturer data: "Nuclear Regulatory Commission or Agreement State Private Contractor".

(9) A complete description of the round type (e.g., CTG, 120MM APFSDS-T M829E3/A3).

(10) National Stock Number; specific to each DODIC.

(11) Location for each DODIC as: "Prepositioned war reserve sites identified by Department of Defense."

(12) Specific inventory data source (i.e., MARCORSYSCOM PM Ammo Phone: 703-432-8938; DSN 378).

3. Receipt of a Depleted Uranium (DU) Ammunition Shipment, Continental United States(CONUS)

a. To the maximum extent possible, all reference (a) items shall be received in a single location.

b. All packages containing radioactive material shall be inspected as soon as possible after being located in an incoming shipment. When a package shows signs of damage (crushed, wet, or visibly damaged), Government-Owned Vehicles (GOVs) shall be surveyed for contamination. GOVs shall not be released until contamination is reduced to the level specified in 49 CFR 173.443. For commercial vehicles, the driver (if available), the carrier, and NAVSEA DET RASO shall be notified of the potential contamination without the vehicle being surveyed.

c. Packages shall not be opened unless directed by the CO, Commander, or OIC as a result of package damage or discrepancy.

d. The receipts of a DU munitions shipment arriving under the requirements of Department of Transportation-Special Permit (DOT-SP) 9649, which show evidence of degradation of package integrity (i.e. packages that are crushed, wet, or damaged) will require that a local command authorized individual:

(1) Monitor the package for radioactive contamination

(2) Monitor the package for radiation levels

e. All packages shall be monitored, as described above, as soon as practical after receipt of the package, but not later than three hours after the package is received at the licensee's facility if it is received during the licensee's normal working hours, or no later than three hours from the beginning of the next working day if it is received after working hours. f. The RI shall immediately notify the final delivery carrier and NAVSEA DET RASO when:

(1) Removable radioactive surface contamination exceeds the limits of 10 CFR 71.87(i) or 49 CFR 173.443  $\,$ 

(2) External radiation levels exceed the limits of DOT-SP 9649 for a DU ammunition shipment.

4. <u>Depleted Uranium (DU) Ammunition Receipt Records</u>. Material receipt records shall include the following information at a minimum:

a. A copy of the source procurement documentation (i.e., a DD Form 250, DD Form 1149, etc.,) identifying the radioactive material.

b. A copy of the bill of lading or manifest for the shipment.

c. The time of receipt and the radiation survey corresponding to receipt of the radioactive material, under the conditions specified for when a receipt survey is required.

d. Receipt records shall be maintained indefinitely.

5. <u>Depleted Uranium (DU) Ammunition Transfer Records</u>. Material transfer records shall contain the following information at a minimum:

a. A copy of documentation verifying that the receiving command or activity is licensed or authorized by a Naval Radioactive Material Permit or appropriate U.S. NRC/Agreement State license to receive the material.

b. A copy of the bill of lading or manifest for the shipment, if applicable.

c. A copy of the material receipt acknowledgement of receipt from the receiving command or activity.

d. Transfer records shall be maintained indefinitely.

## Control of Radiation Exposure to the Public

1. <u>Dose Limits</u>. Demonstration that individual members of the public will not receive doses exceeding the allowable limits of 10 CFR 20.1302:

a. HOURLY RADIATION EXPOSURE IN UNRESTRICTED AREAS: <0.1 mRem/hr

b. THE MAXIMUM ANNUAL RADIATION EXPOSURE IN UNRESTRICTED AREAS: 24 hr/day X 366 days X <0.1 mRem/hr X 0.11 = <100 mRem

## 2. Radiation Readings

a. The DoD predominantly stores DU ammunition in metal containers, but does use a number of wooden boxes. The maximum penetrating dose rate on the surface of any ammunition package or a pallet of packages is less than the 3.0 mRem/hr dose rate limit required for shipment under DOT-SP 9649. As an example, the maximum penetrating dose rate on the surface of a single container of the largest currently existing DU ammunition round, the M829A3, is 0.34 mRem/hr. The highest dose on contact with a pallet of these containers is approximately 1.03 mRem/hr.

b. Measurements taken at one meter from typical storage arrays of DU ammunition have been recorded to be 0.3 mRem/hour. This is supported by Pacific Northwest Laboratory Report PNL-8983, "Dosimetry of Large Caliber Cartridges: Updated Dose Rate Calculations" (June 1994) for 120 mm cartridges (rounds).

c. Adjacent work spaces will be shielded by walls or other compartments that house the DU ammunition and exposure rates in these areas are expected to be less than 0.1 mRem/hour, this given the weak gamma radiation (<100 keV) given off by DU, along with the increased distance from the storage arrays.

d. The time spent in work locations that are adjacent to restricted areas, by members of the public, is conservatively assumed to be 50 percent of the time spent for a normal work week with at least two weeks off for holidays and leave time; (50 weeks/yr) X (20 hrs/week) = 1,000 hrs/yr. Therefore, the occupancy factor for affected spaces is determined from the formula provided in Nuclear Regulatory Guides (NUREG-1556 series) which requires 366 days to be used in the calculation to account for leap years:

(1) (1000 hrs/yr)/(24 hr/day \* 366 days/yr) = 0.11

(2) Berthing areas will not be co-located adjacent to DU ammunition storage areas.

3. <u>Restricted Access</u>. In accordance with references (j), (k), (l) and local requirements, the command in possession of DU ammunition for storage purposes shall have security restrictions on access and include appropriate physical security measures to ensure unauthorized individuals or general members of the public do not gain access to DU ammunition.

## Methods for Monitoring Personnel for Occupational Radiation Exposure

1. <u>Personal Monitoring Devices</u>. From the data provided in Chapter 5 and consistent with past practices involving DU ammunition, radiation medical examinations and the use of personal monitoring devices are not required under the conditions of reference (a) for personnel associated with normal activities involving DU ammunition handling and storage. For the majority of their useful lifetime, DU ammunition items remain in their containers and are stored in secure facilities. When outside of their container, ammunition items are handled for short time periods. In addition, workers enter or work in ammunition storage buildings on a very infrequent basis.

2. <u>Medical Qualification</u>. The RSO and ARSOs are exempt from the requirement to be medically qualified for occupational exposure to ionizing radiation per reference (c), Section 2.5.2 and reference (g).

## Radiation Safety Training

1. <u>Radiation Safety Officer (RSO) and Assistant Radiation Safety Officer</u> (ARSO). The MARCORSYSCOM RSO and ARSO shall meet and maintain the training requirements of reference (c), Section 2.8.3

2. <u>Authorized Users</u>. Authorized Users (AUs) (those that handle DU ammunition) shall be trained as non-radiation workers and they shall complete training required by reference (c), Section 2.8.6, by lectures, demonstrations, video, or self-study courses. The non-radiation worker training material will be provided upon request by the MARCORSYSCOM RSO to the respective command RI for the training of AUs at their commands.

3. <u>Non-Radiation Worker</u>. Non-radiation workers may require access to posted radiation areas to perform specific functions and receive ionizing radiation exposure incidental to performing normal work tasks. Specific to this Order, this level of non-radiation worker training is appropriate for normal handling and use of DU ammunition.

a. <u>Audience</u>: Personnel assigned the duties of a non-radiation worker as described above. Non-radiation workers shall receive initial training before beginning work around DU ammunition.

b. Prerequisite: None.

c. <u>Records</u>: Training records will be retained as required by reference (c), Section 2.26.5 by the RI. Copies of completed training records shall be provided to the MARCORSYSCOM RSO.

d. Testing Requirements: None.

e. Outline

(1) Sources of radiation in areas they may frequent.

(2) Potential hazards associated with radiation sources in areas they may enter.

(3) Biological effects and risks associated with exposure to ionizing radiation from internal or external sources.

(4) Use and meaning of radiation warning signs and barriers.

(5) Procedures to avoid and reduce radiation exposures.

(6) Personnel dosimetry, bioassay, and/or internal monitoring requirements.

(7) Biological effects of exposure to the embryo/fetus if the person will receive greater than 100 mRem per year.

4. <u>Non-Radiation Worker Refresher Training</u>. Each non-radiation worker shall receive annual refresher training. The duration of training shall cover at least the scope of the initial training requirement. Additional refresher

training is required if there are significant changes in potential hazards associated with DU ammunition or areas they may enter. Those changes will be covered in the refresher sessions. Emergency personnel, including firefighters and medical responders, shall receive training on emergency exposure limits and the importance of medical treatment over contamination concerns.

5. <u>Members of the Public and Other Organizational Personnel Working in</u> <u>Proximity to Depleted Uranium (DU) ammunition</u>. While members of the public are not involved in the use of DU ammunition, concerns about the presence of radiation and/or radioactive material warning signs may be allayed by briefing those members of the public before they begin work adjacent to radiological areas where DU ammunition is used.

a. <u>Audience</u>: Members of the public that work adjacent to radiological areas where DU ammunition are used.

b. Prerequisite: None.

c. <u>Records</u>: Training records will be retained as required by reference (c), Section 2.26.5.

d. Testing Requirements: None.

e. Outline

(1) A description of radiation warning signs and the requirement to heed the warnings.

 $(2)\ \mbox{Members}$  of the general public are prohibited from entering radiation areas.

(3) Members of the general public will not receive radiation doses greater than 100 mRem from DU ammunition in a year.

## Operating and Emergency Procedures (OEPs)

1. <u>Background</u>. Radiation OEPs for DU ammunition are provided in this Order for use at all commands that possess and store DU ammunition. Commands that are in possession of DU ammunition shall not generate separate or additional command radiation safety instructions. Request for changes and corrections to this instruction shall be forwarded to the MARCORSYSCOM RSO for evaluation and approval.

2. <u>Emergency Response Actions</u>. Fires shall be reported in accordance with General and Local Fire Bills. DU ammunition items are designed to withstand extreme environmental conditions and rough handling without being a hazard to either the user or the environment. Accidents involving DU components that are not associated with a fire or the threat of a fire pose little or no radiological hazard and will be handled in accordance with local emergency response procedures for ammunition and explosives, and for any subsidiary hazards (i.e. radiological, chemical, explosive). Reference (y), Department of Transportation Emergency Response Guide Numbers 112 and 114 shall be referenced for transportation incidents involving DU ammunition.

## 3. Fires in Depleted Uranium (DU) Munition Storage Areas

a. The response to a fire involving DU ammunition is generally based upon the location of the fire, the potential threat to human life, and the explosive hazard associated with the munitions involved in the fire. In all cases, the senior fire officer present will make fire-fighting decisions.

b. Fires involving DU ammunition items have a dual hazard. The primary hazard is that of the explosives associated with the munitions. Secondary to the explosive hazard is the potential radiation hazard associated with oxidized DU. When DU ammunition items become involved in a fire, a very small portion of the DU may become aerosolized and migrate with the smoke plume. The concentration of DU to be found in the inhalation exposure pathway from a fire plume involving DU munitions or armor is low to insignificant based on data collected from various laboratory and field studies of burning DU penetrators and armor (e.g. DoD, Office of the Special Assistant for Gulf War Illnesses. Environmental Exposure Report: Depleted Uranium in the Gulf (II), 2000).

c. The majority of the DU involved in a fire remains at the scene. This DU can pose an external radiation hazard if it remains in contact with the skin for an extended period of time. The DU remaining in the vicinity of the fire has been analyzed and found to be highly non-respirable and highly nonsoluble in lung fluid. The small portion of the DU that is respirable can be an internal radiation hazard through inhalation if it is suspended in the air. Suspension could occur due to wind, explosion, or the activity of recovery crews. Because the DU, which remains at the scene of the fire, is highly non-soluble in lung fluid, the primary internal hazard of this DU is not chemical toxicity, but radiation exposure to the lungs.

d. Historically, the occurrence of fires or explosions involving finished ammunition items for all services is rare. Burn tests conducted by the Army and Air Force have shown that only small quantities of DU are released into the environment if a fire should involve ammunition items containing DU components. The extreme density of DU tends to result in its being deposited in the immediate area of the fire.

e. Fires aboard ocean-going vessels are generally fought to the maximum extent possible by all available personnel. Land-based fires involving munitions with a mass detonation, fragmentation, or mass fire hazard are not fought on a routine basis. For these types of fires, the area is generally evacuated and attempts are made to fight incipient fires that are generated by the main fire. Fires involving munitions with a moderate fire hazard are generally fought. Additionally, fires posing a serious threat to human life may also be fought.

f. No special fire-fighting equipment is needed beyond that commonly worn by fire-fighting personnel. Typical fire-fighting gear and selfcontained breathing apparatus is adequate. Although the smoke plume poses a small radiation hazard, personnel downwind of a fire involving DU ammunition should be evacuated mostly due to the possible presence of other nonradiological products in the smoke.

# 4. Detection of Contamination

a. Commands will consider a surface contaminated if one or more of the levels listed in Appendix D, table D-1 are exceeded. These levels apply to alpha emission of the material covered by reference (a) and the associated decay products.

b. The detection of contamination at DU ammunition storage and use areas, either by direct scan surface surveys or on swipe samples collected from these storage and use areas, shall be investigated by the command RI. These occurrences shall be reported to the MARCORSYSCOM RSO (commercial 703-432-8784, DSN 378-8784) for collection of contamination survey data related to the condition.

5. <u>Transportation Incidents</u>. Initial notifications of a transportation incident will be made by both the qualified Hazardous Material (HAZMAT) carrier providing shipment of DU munitions and by emergency first responders that have jurisdiction over the incident scene. Local authorities providing first response are expected to make required notifications to their respective state and federal authorities. The qualified HAZMAT carrier and/or authorities that have jurisdiction over the incident scene are expected to notify the intended recipient (transferee) and the shipper (transferor). Those parties are required to report the incident in accordance with the below instructions and their local requirements.

6. <u>Reports and Notifications</u>. Commands shall immediately report radiological incidents, upon their discovery of the event, to the MARCORSYSCOM RSO. The MARCORSYSCOM RSO will be responsible for initial notification of NAVSEA DET RASO per reference (c), Section 2.27.1.2. The MARCORSYSCOM RSO will also be responsible for initial notification of CMC-SD Health Physicist. The following is a list of applicable events considered as radiological incidents:

# a. <u>Initial Reports</u>

(1) Personnel contamination above the levels of reference (c), Table 2-2.

(2) A mishap resulting in the inhalation or ingestion of a measurable quantity of radioactive material.

(3) Unauthorized or accidental entry of personnel into a radiation area and the person(s) receives an estimated unmonitored exposure of greater than two mRem.

(4) Spills of radioactive material outside controlled areas.

(5) Theft or loss of radioactive material (DU ammunition).

(6) Receipt of packages with contamination or radiation levels in excess of 10 CFR 71 limits.

(7) Discharges or spills of material or fluids that might be considered pollutants which endanger critical water areas, have the potential to generate public concern, become the focus of enforcement action, have domestic or international implications, or pose a threat to public health or welfare.

(8) Unauthorized disposal of radioactive material (DU ammunition).

(9) Incidents defined in 10 CFR 40.60.

b. Follow up written reports shall be made within 10 days with update reports to be determined by NAVSEA DET RASO. The written report shall include:

(1) A description of the operation, date, time, individual(s) involved, and doses received.

(2) A description of the circumstances under which the accident or incident occurred.

(3) Exposures of individuals to radiation, circumstances under which the exposures occurred, and the possible total effective dose equivalent to persons in unrestricted areas;

(4) A determination of the cause(s), immediate actions taken, longterm corrective actions planned to prevent recurrence, and the Plan of Actions and Milestones.

(5) Assessment of the radiological significance of the event.

(6) Signature of the Commander, CO, or OIC.

## 7. Reports of Theft or Loss of Permitted Radioactive Material

a. Immediately after its occurrence becomes known to the command, any lost, stolen, or missing permitted radioactive material shall be reported to the MARCORSYSCOM RSO. The MARCORSYSCOM RSO will be responsible for initial notification by telephone to NAVSEA DET RASO ((757) 887-4692). If after normal work hours, the MARCORSYSCOM RSO shall contact the emergency number provided on NAVSEA DET RASO's after-hours voice message. The MARCORSYSCOM RSO will also be responsible for initial notification of CMC-SD Health Physicist ((703) 604-4122). Follow up written reports shall be made within 10 days with update reports to be determined by NAVSEA DET RASO. The written report shall include:

(1) A description of the licensed material involved, including kind, quantity, and chemical and physical form.

 $(2)\ A$  description of the circumstances under which the loss or theft occurred.

(3) A statement of disposition, or probable disposition, of the licensed material involved.

(4) Exposures of individuals to radiation, circumstances under which the exposures occurred, and the possible total effective dose equivalent to persons in unrestricted areas.

(5) Actions that have been taken, or will be taken, to recover the material.

(6) Procedures or measures that have been, or will be, adopted to ensure against a recurrence of the loss or theft of the licensed material.

(7) Signature of the Commander, CO, or OIC.

b. A Missing, Lost, Stolen, Recovered (MLSR) report must be generated within 48 hours per reference (o).

8. <u>Additional Reports</u>. The RI shall submit to the MARCORSYSCOM RSO no later than 15 January of each year an inventory of all DU material possessed by the command on 31 December of the previous year.

9. Notification Information. OIC, Naval Sea Systems Command Detachment, Radiological Affairs Support Office, 160 Main Road, Yorktown, VA, 23691, Telephone Number: DSN 953-4692 or Commercial: (757) 887-4692, PLA: NAVSEA DET RASO YORKTOWN VA//00//. If the OIC NAVSEA DET RASO cannot be contacted, notify either:

a. Chief of Naval Operations (N45), 2000 Navy Pentagon, Washington, DC, 20350, Telephone Number: DSN 225-5272 or Commercial: (703) 695-5272, PLA: CNO WASHINGTON DC//N45//

b. Commander (SEA 04N), Naval Sea Systems Command, 1333 Isaac Hull Ave SE, Washington, DC, 20376, Telephone Number: DSN 326-2414 or Commercial: (202) 781-2414, PLA: COMNAVSEASYSCOM WASHINGTON DC//04N//

c. Commandant of the Marine Corps, Safety Division, 701 S. Courthouse Road, Rm 20050, Arlington, VA, 22204, Telephone Number: DSN 664-4122 or Commercial: (703) 604-4122, (571) 289-8133, PLA: CMC SD WASHINGTON DC//

# Facility Diagrams (Storage Areas, Restricted Areas and Adjacent Areas of Personnel Occupancy)

# 1. General Guidelines

a. Primary use and storage of DU ammunition will be for long-term (i.e. war reserve) and short term (i.e., unit basic load), worldwide storage, handling and transportation Marine Corps DU Ammunition at selected DoD facilities within the United States (US) and selected DoD and Host Nation Facilities Outside the US authorized for the storage of conventional ammunition by the DoD. Therefore, any DoD or Host Nation Facility authorized to store conventional ammunition may be designated as an authorized DU ammunition storage site. Specific facility diagrams cannot be provided for these storage and use locations.

b. DU ammunition owned by the Marine Corps that is stored under another DoD service's control, are not considered to be in Marine Corps possession. Storage of DU ammunition at these sites is authorized under the other services' permit or NRC license.

c. DU ammunition owned by another DoD service that is stored under Marine Corps or Navy control is considered to be covered by reference (a) for possession only.

d. DU ammunition may be loaded in transportation conveyances (i.e., vehicles, rail cars, aircraft, etc.) and vessels in direct or indirect support of Marine Corps operations and mission assignments (i.e., support of readiness, training, deployment, and combat).

e. DU ammunition will be stored in locations appropriate for conventional ordnance in accordance with reference (k).

f. Radiation signs and labels shall bear the radiation trefoil symbol and the wording required of 10 CFR 20.1901 and 10 CFR 20.1902.

g. "CAUTION - RADIOACTIVE MATERIAL" signs shall be posted and be easily viewable by anyone approaching the entrance to DU ammunition storage locations. DU ammunition shall not be stored with other flammable materials, photosensitive items, food products or other incompatible commodities. No eating, drinking, gum chewing, tobacco use, or the application of cosmetics will be allowed in DU ammunition storage areas. The boundaries of the storage location shall be surveyed and checked whenever new packages are received to determine proper warning signs. Radiation levels at the storage area boundaries (i.e., external walls) shall not exceed 2 mRem/hr.

h. "CAUTION - RADIOACTIVE MATERIAL" signs shall be posted as to be easily viewable by anyone approaching designated storage locations. The "CAUTION - RADIOACTIVE MATERIAL" signs shall be removed when DU ammunition is no longer present at the affected storage location.

i. "CAUTION - RADIATION AREA" signs shall be posted as to be easily viewable by anyone approaching the entrance to designated storage locations where radiation levels at 30 centimeters from the DU ammunition or from any

surface that the radiation/from the DU ammunition penetrates exceeds 2
mRem/hr.
The "CAUTION - RADIATION AREA" signs shall be removed when exposure rates
fall below 2 mRem/hr at 30 centimeters from the DU ammunition or from any
surface that the radiation from the DU ammunition penetrates.

j. "RADIOACTIVE CONTAMINATION AREA" signs shall be conspicuously posted on the boundary of use locations where measured contamination levels exceed the values of reference (c), Table 2.2, values. Radiation rope shall be used as a barrier for control and prevention of inadvertent entry into these areas. The requirements of referenced (b), Section 2.20, shall be implemented for contamination control if contamination is detected. "RADIOACTIVE CONTAMINATION AREA" signs shall only be removed by the RSO after a thorough radiological survey and assessment of the affected areas and work surfaces is performed.

k. "CAUTION-RADIOACTIVE CONTAMINATION INSIDE" shall be marked on radioactive material containers that are internally contaminated in excess of the levels of reference (c), Table 2-2.

l. Installation fire maps required by reference (k) shall be updated to identify the storage location of DU ammunition.

m. Radiation and radioactive contamination related signs shall be destroyed or defaced prior to disposal of the signs.

2. Security. DU ammunition shall be secured in accordance with references (k) and (o).

## 3. Postings

a. 10 CFR 19 requires all activities and persons who receive, possess, use or transfer materials covered by reference (a), to prominently post certain documents. The documents, notices, and forms posted pursuant to this section shall appear in a sufficient number of places to permit individuals who receive, store or transfer material covered under reference (a) to observe them on the way to or from any particular location to which the document applies. The documents shall be conspicuous and replaced if defaced or altered. All DU ammunition storage locations, i.e., magazines, ready service lockers, mil-van containers, and cargo holds (afloat and ashore), shall be posted with current copies of the following:

(1) NRC Form 3, "Notice to Employees".

(2) A copy of any notice of violation involving radiological working conditions, proposed imposition of civil penalty, any order by the NRC, and any response to the violation.

b. The following shall either be posted in the same location, or if posting of a document specified below is not practicable, the command may post a notice that describes the document, including the name of the individual to whom reports may be made, and states where they may be examined:

(1) Reference (d) Parts 19, 20, 21 and 40.

(2) A current copy of reference (a).

(3) A copy of this instruction which contains the operating and emergency procedures applicable to the licensed activities.

(4) Section 206 of the 1974 Energy Reorganization Act found in Chapter 3 of reference (z).

(5) NRC Regulatory Guide 8.13 and 8.29 of Reference (aa).

## Types and Frequencies of Required Surveys

1. <u>Background</u>. Figure 10-1 of this Chapter provides an overview of survey types, RADIAC devices, locations, and survey frequencies specific to DU ammunition. The survey methods and guidance described in Chapter 3 shall be used for these surveys.

2. <u>Depleted Uranium (DU) Ammunition Shipment Receipt</u>. The AN/PDQ-4 RADIAC Set (IM-265/PDQ RADIAC meter equipped with a DT-685/PDQ and DT-304 detector set), or equivalent, will be used for the measurement of contamination when receiving damaged packages containing DU ammunition. In addition, an IM-231 or an AN/PDQ-1 RADIAC Set will be used to measure radiation exposure rates for any receipt at a storage location or interim transfer (staging) area to verify radiation exposure levels are less than 2.0 mrem/hr in an unrestricted area.

3. <u>Depleted Uranium (DU) Ammunition Shipment</u>. The AN/PDQ-4 RADIAC Set (IM-265/PDQ RADIAC meter equipped with a DT-685/PDQ and DT-304 detector set), or equivalent, will be used for the measurement of contamination on packaging surfaces for those packages that contain DU ammunition. For compliance with reference (e) and (p), a swipe sample shall be collected over an area of at least 300cm<sup>2</sup> on each packaging and field counted with the AN/PDQ-4. For compliance with reference (e) and DOT-SP 9649, an IM-231 or an AN/PDQ-1 RADIAC Set will be used to measure radiation exposure rates on the exterior of each packaging.

## 4. Contamination Surveys

a. Contamination surveys shall be performed using a combination of swipes and direct survey RADIAC equipment. An AN/PDQ-4 RADIAC Set (IM-265/PDQ RADIAC meter equipped with a DT-685/PDQ and DT-304 detector set), or equivalent, will be used for receipt surveys, when shipping packages, and for measurement of contamination levels when DU ammunition has been damaged. Swipe samples (100 cm<sup>2</sup>) will be collected and analyzed where detectable levels of radioactivity are found with the RADIAC.

b. Contamination survey records will include the following information, at a minimum:

- (1) The survey date and time.
- (2) The survey location.
- (3) A diagram of area surveyed.
- (4) The locations of contamination readings/wipes.
- (5) The RADIAC efficiency for the radionuclide(s) of concern.
- (6) The gross and net count rates.
- (7) The background count rate.
- (8) All observed contamination levels (in terms of activity).

(9) A description of the RADIAC(s) used, including model number and serial number.

(10) The last calibration date for each RADIAC used.

(11) The name of the individual(s) who performed the survey.

(12) The date the MARCORSYSCOM RSO reviewed the contamination survey and his/her signature.

c. Contamination survey results shall be forwarded by the command to the MARCORSYSCOM RSO for review and shall be maintained indefinitely. An example survey report form is provided in Figure 10-2 of this Chapter.

5. <u>Radiation Surveys</u>. Radiation surveys will be performed for material receipt, for shipment package surveys, and as specified in DU ammunition storage locations that meet the reference (c) posting criteria for a "Radiation Area" and "Radioactive Material Storage Area.

a. Radiation survey records will include, at a minimum, the following information:

(1) The survey date and time.

(2) The name of the person(s) conducting the survey.

(3) The DODIC, nomenclature, and National Stock Number for DU ammunition types involved.

(4) Building number and room number of the survey.

(5) The identity of the radiation survey instruments used, including model and serial numbers and dates of last calibration.

(6) The source (DU ammunition) activity in curies. The activity can be calculated by taking the mass of the DU ammunition involved (Kilograms) and multiplying it by the specific activity  $(3.36 \times 10^{-4} \text{ Curies/Kilogram})$ .

 $(\ensuremath{\left. 7\right)}$  Information on the location of DU ammunition types at the time of the survey.

(8) The date the MARCORSYSCOM Ammo RSO reviewed the radiation survey and his/her signature.

b. Radiation survey results shall be forwarded by the command to the MARCORSYSCOM Ammo RSO for review and shall be maintained indefinitely. An example survey report is provided as Figure 10-2 of this Chapter.

SURVEY TYPE	RADIAC TYPE	LOCATION	FREQUENCY
Radiation	IM-231 or AN/PDQ-1	Marine Corps/Navy DU ammo storage and interim receipt/transfer locations	Upon receipt at these locations to verify less than 2.0 mrem/hr in the unrestricted area
Radiation	IM-231 or AN/PDQ-1	Marine Corps/Navy DU ammo shipment prep locations	Shipment package surveys
Radiation	IM-231 or AN/PDQ-1	Marine Corps/Navy DU ammo storage locations posted as Radiation and/or Radioactive Material Storage Areas	<u>Monthly</u> : In occupied storage areas and areas adjacent to these areas. <u>Annually</u> : In unoccupied storage areas.
Contamination	AN/PDQ-4 RADIAC SET	Marine Corps/Navy DU ammo shipment prep locations	Shipment package surveys
Contamination	AN/PDQ-4 RADIAC SET	Marine Corps/Navy DU ammo shipment receiving locations	Shipment receipt survey (damaged package)
Contamination	AN/PDQ-4 RADIAC SET	Marine Corps/Navy DU ammo emergency incident locations	As affected

Figure 10-1.--Types and Frequencies of Required Surveys

KAD	IATIO	N AND CON	TAMINZ	ATION	I SURVE	Y REP	ORT		
PERSON(S) PERFORMING SURVEY:	STA TIM	RT DATE & E	x	END TIME	DATE AN	1D	SURVEY (CIRCL)	TYPE E)	
							CONTAM: RADIAT:	INATIO ION	N /
NOMENCALTURE FOR THE RADIATION SOURCE (E.G SEALED SOURCE, MACHIN MODEL AND SERIAL NO.)	FOR RAD	IATION INTENS ACTIVI	I SUR ITY OR TY I	VEYS ON IN MREN  N CURIE	ILY: 1/HR @ ES FOF	D 1 METE R BETA-G	R: AMMA S	SOURCE :	
RADIACs/PROBES (MODEL NUMBER) SET A METER	L RS CTOR ND .)	LAST CALIB DATE	RATON		INSTRU COMPLE (SAT/U	JMENT STED JNSAT )	CHECKS	RADIA EFFIC (AS APPLI	AC CIENCY CABLE)
							SWIPE		RADIAT
ITEM LOCATION G DESCRIPTION (	ROSS cpm)	BKGD (cpm)	NET (cpm)	т( ( с	OTAL dpm/100	Cm <sup>2</sup> )	SAMPLE (dpm/10 )	00cm²	RADIAI ION (mR/hr )

RADIA	RADIATION SAFETY OFFICE REVIEW:							
PRINT	NAME :	S	IGNATURE	:		DA'	FE REVIEWED:	

Figure 10-2.--Radiation and Contamination Survey Report

# Leak Test Procedures and Training Required to Perform Leak Tests

Leak test procedure and training requirements are not applicable to DU ammunition. DU ammunition types are not "sealed sources" as defined in standards such as ANSI/HPS N43.6-1997. A "Registry of Radioactive Sealed Sources and Devices Safety Evaluation of Device" is not required for DU ammunitions of this type.

# Sample Analysis Procedures and Training Required to Perform Analysis

Leak test sample analysis procedures and training required to perform analysis is not applicable to this Order or the requirements of reference (a).

# Equipment Maintenance Procedures

Invasive work, or any form of destructive analysis or testing on DU ammunition is prohibited. Therefore, maintenance procedures are not applicable to this Order.

#### Radioactive Material Transportation

## 1. General Requirements

a. DU ammunition offered for transportation by Naval and Marine Corps commands shall meet Defense Transportation Regulation (DTR) 4500.9R and 49 CFR DOT requirements for shipment of radioactive materials. The current version of reference (p) (DOT-SP 9649) will apply for DU ammunition shipments.

b. The current version of reference (p) provides for specific exemptions to 49 CFR and provides specific shipping instructions under the conditions specified for these exemptions. The current version of DOT-SP 9649 can be located at http://phmsa.dot.gov/hazmat/regs/sp-a/special-permits. For any questions regarding the current status of DOT-SP 9649, contact the U.S. Army Joint Munitions Command at DSN 793-2969 or 793-0338. If the special permit has expired and has not been renewed, do not perform DU ammunition shipping activities without first contacting the MARCORSYSCOM RSO.

c. Per the requirements of reference (p), DU munitions shipments will be shipped under the subsidiary hazard of either "Radioactive material, excepted package - articles manufactured from depleted uranium" or "Radioactive material, low specific activity material (LSA-I)", depending on the packaging configuration.

d. DOT Emergency Response Guide Numbers 112 and 114 shall be incorporated into shipping documents when shipping DU ammunition under the subsidiary hazard of "Radioactive Material, LSA-I" under paragraph 4.b of reference (p).

e. The RI shall defer all interpretations of the specific transportation requirements for DU ammunition to their command-appointed transportation officer (or other command-appointed designee). The command-appointed transportation officer shall be HAZMAT trained (for shipment certification of radioactive material packages) in accordance with the requirements of the DTR and 49 CFR. If the RI is trained to these requirements and is authorized by the command to act in this capacity, then he/she may certify the shipment.

f. The command-appointed transportation officer (or other commandappointed designee) ensures that all packages offered for transportation or transported by the command conform to 49 CFR and the DTR.

g. DOT and DTR regulations shall apply to the movement of radioactive material over DoD controlled and uncontrolled roads.

h. Military air shipments of DU munitions shall comply with AFMAN 24-204/TM 38-250/MCO P4030.19/NAVSUP Pub 505/DLAI 4145.3/DCMAD1 (current Rev.), "Preparing HAZMAT for Military Air Shipments."

# 2. Contamination Surveys of Depleted Uranium (DU) Packaging

a. Contamination surveys of DU packaging for contamination control in accordance with SP-9649 and DOT 49 CFR 173.443. The levels of non-fixed (removable) radioactive contamination on the external surfaces of each

package that is offered for transportation may not exceed the limits set forth in Table 9 of DOT 49 CFR 173.443, at any time during transport.

b. The level of non-fixed (removable) radioactive contamination on the external surfaces of each package offered for transport must be kept as low as reasonable achievable.

c. An AN/PDQ-4 RADIAC (IM-265/PDQ RADIAC meter equipped with a DT-685/PDQ and DT-304 detector set) shall be used for meeting the requirements of DOT 49 CFR 173.443:

(1) Wipe an area of 300cm<sup>2</sup> on the package surfaces with an absorbent material, using moderate pressure, and measure the activity on the wiping material. Sufficient measurements must be taken in the most appropriate locations to yield a representative assessment of the non-fixed (removable) contamination levels. The amount of radioactivity measured on any single wiping material in CPM is divided by the surface area wiped and divided by the prescribed RADIAC efficiency:

Disintegrations Per Minute (DPM) =  $\frac{CPM - Background}{(300cm^2)*(0.1)}$ 

Where 0.1 is the RADIAC efficiency approved for DU

NOTE: The wiping material (a "swipe sample") that is collected for contamination determinations on the package shall be taken to a low background area for measurement using the AN/PDQ-4 RADIAC Set. Background count-rates shall not exceed 300 CPM in the area of the measurement on the wipe.

(2) To obtain a measurement of the swipe sample, in CPM for conversion to DPM, use an AN/PDQ-4 as described below. Alternatively, cotton swabs (or filter media of not more than two inches in diameter} can be collected on the package surface and sent under an approved purchase order to a NRC authorized service provider. The service provider would analyze the sample and record the results in DPM. These results shall be converted to DPM/cm2 for comparison to the surface contamination limits of DOT 49 CFR 173.443, Table 9. Divide the result in DPM/300cm<sup>2</sup> by 300 to obtain DPM/cm<sup>2</sup>.

3. Radiation Surveys of Depleted Uranium (DU) Packaging

a. Radiation surveys on DU packaging will be taken on contact with package surfaces and at one meter for the Transportation Index (TI). The TI of a package that is prepared for shipment in accordance with DOT requirements is the maximum radiation level that is measured with an appropriate instrument at one meter from the package surface. TI is expressed in mrem/hour (or uSv/hour). One mrem/hour is equal to 10 uSv/hour.

b. An IM-231 (series) RADIAC or an AN/PDQ-1 RADIAC Set shall be used for measuring radiation exposure rates associated with DU ammunition packages prepared for transportation in accordance with DOT-SP 9649. All accessible surfaces of the packaging shall be surveyed for maximum radiation levels. Maximum radiation levels at one meter from the packaging shall also be determined for the package TI.

c. In accordance with DOT-SP 9649, for DU munitions that will be shipped "Radioactive material, excepted package - articles manufactured from depleted

uranium", the maximum radiation levels on any external surface of the package, overpack, or unitized/palletized group of packages must not exceed 0.025 mSv/hr (2.5 mrem/hr).

d. In accordance with DOT-SP 9649, for DU munitions that will be shipped "Radioactive material, (LSA-I)", the maximum radiation levels on any external surface of the package, overpack, or unitized/palletized group of packages must not exceed 0.030 mSv/hr (3.0 mrem/hr).

4. <u>Records</u>. Records of DU shipments and surveys are permanent and shall be maintained indefinitely according to their National Archives and Records Administration-approved disposition instructions.

## Radioactive Waste Management

1. As applicable for a specific DU ammunition type, MARCORSYSCOM PM Ammo shall provide DU ammunition disposition instructions to Naval and Marine Corps commands as required or as requested.

2. Disposal of DU ammunition is coordinated with the US Army for transfer to their custody for demilitarization. Transfers of Marine Corps assets are processed through the OIS-MC for entry into a demilitarization account maintained by MARCORSYSCOM PM Ammo. Transfer records are maintained by the affected command that made the actual transfer of DU ammunition for disposal or demilitarization.

3. References (b) and (m) provide requirements for waste management and transfers of radioactive material for disposal.

# Appendix A

# Radiological Affairs Support Program (RASP) Audit and Deficiency Report Program

## 1. Introduction

a. The MARCORSYSCOM RSO shall develop and manage an effective audit and RDR program, per reference (c), Sections 2.9 through 2.11 and this Order.

b. The audit program encompasses compliance and performance based reviews, to include site visits (as necessary) of commands storing DU ammunition.

c. The purpose of the audit and RDR program is to improve RASP safety, reduce RASP program violations, and prevent mishaps and near misses from occurring through the identification and efficient correction of deficiencies.

d. At any time, any individual can report a suspected discrepancy or violation via the RDR program.

## 2. Radiation Safety Officer (RSO) Audits

a. Per reference (c), Section 2.9.1.5, the RSO shall conduct a RASP audit at least every six months unless otherwise specified in references (a) and (b).

b. Audits shall be performed by the MARCORSYSCOM RSO or ARSO of the applicable areas of reference (c), Sections 2.9.1.6 and 2.9.1.7. The audit checklist provided in Appendix B will be used in the conduct of the audit.

c. In order to effectively evaluate the adequacy of the oversight provided, the audit program will utilize a system comprised of both external and internal audits.

(1) The MARCORSYSCOM RSO or ARSO is responsible for conducting external visits of storage commands bearing responsibility for compliance with reference (a) as part of their audit. Audits will be scheduled such that at least one DU ammunition storage location within the CONUS will be evaluated annually unless no such locations exist. Deployed or underway ships will not be audited.

(2) The RIs for each command possessing DU ammunition under reference (a) shall perform internal audits every six months to verify compliance within their own command elements using Appendix C of this Order. Copies of these audits shall be provided to the MARCORSYSCOM RSO for inclusion into his audit of Section 2.b. above.

## 3. Audit Guides

a. The RASP audit guide of Appendix B will be used when performing audits of MARCORSYSCOM RASP operations. The RASP audit guide of Appendix C will be used when performing audits of RASP operations for commands storing DU ammunition. b. The audit checklists shall be a complete guide to review the applicable areas required per reference (c), Sections 2.9.1.6 and 2.9.1.7. In addition, the checklists may also include other items to check for compliance with this Order, as well as other references deemed appropriate by the RSO. The checklists shall provide references to specific requirements to be checked.

## 4. Conducting the Audit

a. The MARCORSYSCOM RSO or ARSO shall familiarize themselves with the review areas required by the audit checklist. They shall review previous audits and discrepancies, prior to performing the audit, in order to review the effectiveness of corrective actions or identify recurring deficiencies.

b. The MARCORSYSCOM RSO or ARSO will conduct the audit using the audit guide in Appendix B. Audit reports shall include the information required in reference (c), Section 2.26.6.2. Findings shall be linked to specific requirements. Recommendations for process improvements for the area observed are encouraged.

# 5. Audit Adjudication

a. Findings or recommendations from audits will be used to generate RDRs. The organization or command responsible for addressing a finding shall document, by memoranda to the RSO, the results of any causal analyses and all corrective actions planned or taken. Actions incomplete when the audit response is forwarded shall be tracked to completion. The organization or command shall forward documentation to the RSO when the tracked actions are complete. The RSO may exercise the right to suspend operations for findings or recommendations that are not expeditiously addressed or corrected per the prescribed timelines.

b. A summary of the audit results shall be documented as a memorandum from the RSO to COMMARCORSYSCOM, who will endorse the audit. The endorsement shall not be signed by direction.

## 6. Radiological Deficiency Report (RDR) Program

a. All RASP deficiencies, abnormal conditions, and improvement items, regardless of origin, will be managed as RDRs in the RDR program. Each RDR will be documented in accordance with paragraph 2.11.2 of reference (c) and may include attached references or explanatory documents. Contact the MARCORSYSCOM RSO/ARSO or NAVSEA DET RASO to obtain a sample form.

b. At any time, an individual may report a deficiency or improvement item via the RDR program by completing the applicable section of the RDR report provided at the end of this attachment.

c. RDRs will be adjudicated per the following process, unless otherwise directed by the RSO.

(1) The RSO or ARSO will review each proposed RDR to ensure proper regulatory basis, plausibility of remedial action, etc. and accept into the RDR system if appropriate.

(2) The RSO or ARSO will assign an RDR number, ensure the information is entered into the RDR database, and forward the RDR and any required

instructions to the organization or command required to address the deficiency.

(3) The organization or command will perform any required analysis and develop a plan for corrective action and submit these to the RSO for review. If it is appropriate that the RSO address the deficiency (e.g., the deficiency concerns the RASP itself), the RSO will perform any required analysis and develop and execute corrective actions.

(4) The RSO or ARSO will review all analysis and corrective actions for adequacy. Inadequate analysis or corrective action plans will be returned to the organization or command for reconsideration.

(5) Once an acceptable analysis and corrective action plan is received and agreed to, the RSO will track the corrective action via the RDR program database.

(6) The command or organization addressing the deficiency will inform the RSO when corrective actions are complete by formal correspondence which documents that the actions taken to correct the deficiencies or abnormal conditions are appropriate. The RSO will close the RDR by updating the RDR program database.

#### 7. Radiological Deficiency Report (RDR) Classification and Tracking

a. The RSO will assign an RDR serial number for all findings or recommendations identified in audits, RDRs, or via other means.

b. Each RDR deficiency shall be assigned a level of significance (e.g., Type A, B, C, etc.). The RDR level of significance does not correlate directly to the level of severity for NRC/Navy Master Material License violations that are separately determined. The severity levels are mapped to the following classifications per reference (c), Section 2.11.1.5.

## (1) Incidents

(a) An actual loss of safety or security. It is associated with severe or potentially severe bodily harm to a person and shall be recorded as type "A" on the RDR checklist provided at the end of this attachment.

(b) Reflects the result of a loss of safety or security, but to a lesser extent. It is associated with bodily harm or potential bodily harm to a person and shall be recorded as type "B" on the RDR checklist provided at the end of this appendix.

(c) Failure to comply with radiation exposure control or contamination control requirements such that limits or control levels are exceeded. Exceeding a radiation exposure limit or Administrative Control Level, external or internal contamination of personnel, or releases of radioactivity to the environment above limits are examples of this type of incident and shall be recorded as type "C" on the RDR checklist provided at the end of this attachment.

## (2) Potential Incidents

(a) Exists when there is a realistic potential for the loss of safety or security. It may be associated with systemic failure to accomplish

or meet a RASP regulatory requirement and shall be recorded as type "D" on the RDR checklist provided at the end of this Appendix.

(b) Has more than minor safety or environmental significance. It may be associated with non-systemic failures to accomplish or meet RASP regulatory requirements. If uncorrected, the problem could lead to an incident and shall be recorded as type "E" on the RDR checklist provided at the end of this attachment.

# (3) Deficiency and Improvement Items

(a) Deficiencies have minor safety, health, or environmental significance. These violations typically reflect inadequate documentation of program compliance requirements or minor problems that, if left uncorrected, could lead to a more significant issue and shall be recorded as type "F" on the RDR report provided at the end of this attachment.

(b) Items identified as program improvements, and do not impact RASP compliance, shall be recorded as type "G" on the RDR report provided at the end of this attachment.

c. Incidents are reportable events per reference (c), Section 2.23 and have specific reporting requirements outside the RDR program. The cause and corrective action blocks on the RDR used to initially document the problem are completed by referencing the incident or potential incident report. All incidents and potential incidents require a causal analysis, corrective action, and report as described in reference (c), Section 2.27.1.

d. RASP findings and recommendations will be tracked in a database (RDR Program Database); the database will be developed and maintained by the RSO and will contain, at a minimum, the following information:

- (1) RDR serial number (YY-###, assigned by RSO).
- (2) Date identified or recorded.
- (3) Severity level (e.g., A, B, C, etc.).
- (4) Finding or recommendation description.
- (5) Cause (if applicable).
- (6) Corrective action (if applicable).
- (7) Date reviewed.
- (8) Date closed.
- (9) Additional information to perform trend analysis.

e. The RDR program database shall be reviewed by the RSO in RASP program audits to identify any adverse trends.

# 8. Communication and Community Access

a. In order to communicate lessons learned for local review consideration, identified findings or recommendations, along with the associated root cause analysis and corrective actions will be made available to all RASP personnel associated reference (a).

b. A report of completed audits and associated findings and recommendations, along with their specific completed analysis and corrective actions, will be provided by the RSO to the CO via RASP Command Updates.

c. The APR required per reference (c), Section 2.10, will be forwarded for CO review annually.

9. <u>Record Retention</u>. All records associated with audits, APRs, and RDRs shall be maintained in accordance with reference (n).

# Appendix B

# MARINE CORPS SYSTEMS COMMAND (MARCORSYSCOM) RADIOLOGICAL AFFAIRS SUPPORT PROGRAM (RASP) AUDIT PROGRAM CHECKLIST FOR NAVAL RADIOACTIVE MATERIALS PERMIT (NRMP) 45-67854-L1NP

	NRMP AND RASP PROGRAM INSTRUCTION	YES	NO				
	Does the Radiation Safety Officer (RSO) maintain the NRMP and RASP program instruction current by submitting amendments or applications for renewal in a timely manner and correcting deficiencies as identified? Were Specific due dates for all amendments or renewals met?						
	NRMP 45-67854-L1NP, Amendment No.:						
1	Expiration date:						
-	MCO No.:						
	Ref: NRMP 45-67854-L1NP, NAVSEA S0420-AA-RAD-010, Sections 1.5.2.1 and 2.9.1.6.a						
	DEFICIENCIES/COMMENTS:	•					
	The MARCORSYSCOM RSO maintains current copies of:	T					
	a. NRMP and all cited correspondence						
	b. OPNAVINST 6470.2						
	c. BUMEDINST 6470.10						
	d. NAVMED P-5055						
	e. NAVSEA SO420-AA-RAD-010						
	f. 10 CFR						
2	g. 40 CFR						
	Ref: NAVSEA S0420-AA-RAD-010, Section 1.7.1						
	DEFICIENCIES/COMMENTS:						

.

	NAVAL RADIOACTIVE MATERIAL PERMIT MAINTENANCE	YES	NO
	Does the RSO maintain records and documentation that demonstrate compliance with NRMP conditions?		
	Ref: NAVSEA S0420-AA-RAD-010, Sections 1.5.2.r and 2.9.1.6		
	DEFICIENCIES/COMMENTS:		
3			
	Have commands that store and handle Depleted Hyanium (DII)		
	ammunition (Shore/Afloat) designated a Responsible Individual		
	radiological aspects of DU munitions have they provided these		
	names and appointment letters the RSO?		
	Ref: NRMP 45-67854-L1NP		
4	DEFICIENCIES/COMMENTS:		
	PUBLIC DOSE	YES	NO
	Are DU ammunition storage locations used in a manner that keeps radiation doses to members of the public below 100 mrem		
	per year? In addition, is DU ammunition stored in a manner so that members of the public are not exposed to radiation dose rates exceeding two mRem/hour		
	per year? In addition, is DU ammunition stored in a manner so that members of the public are not exposed to radiation dose rates exceeding two mRem/hour.		
	per year? In addition, is DU ammunition stored in a manner so that members of the public are not exposed to radiation dose rates exceeding two mRem/hour. Ref: NAVSEA S0420-AA-RAD-010, Section 2.24.2		
5	<pre>per year? In addition, is DU ammunition stored in a manner so that members of the public are not exposed to radiation dose rates exceeding two mRem/hour. Ref: NAVSEA S0420-AA-RAD-010, Section 2.24.2 DEFICIENCIES/COMMENTS:</pre>		
5	<pre>per year? In addition, is DU ammunition stored in a manner so that members of the public are not exposed to radiation dose rates exceeding two mRem/hour. Ref: NAVSEA S0420-AA-RAD-010, Section 2.24.2 DEFICIENCIES/COMMENTS:</pre>		
5	<pre>per year? In addition, is DU ammunition stored in a manner so that members of the public are not exposed to radiation dose rates exceeding two mRem/hour. Ref: NAVSEA S0420-AA-RAD-010, Section 2.24.2 DEFICIENCIES/COMMENTS:</pre>		
5	<pre>per year? In addition, is DU ammunition stored in a manner so that members of the public are not exposed to radiation dose rates exceeding two mRem/hour. Ref: NAVSEA S0420-AA-RAD-010, Section 2.24.2 DEFICIENCIES/COMMENTS:</pre>		

	PHYSICAL INVENTORIES	YES	NO
	Are command-assigned RIs conducting an annual inventory of the command's DU ammunition and is it being reported through the Ordnance Information System (OIS)? When any change occurs to the DU inventory held at the Command, is the transaction reported immediately in the OIS?		
б	Ref: NAVSEA S0420-AA-RAD-010, Section 9.3.3.f., MCO 8015.3		
	DEFICIENCIES/COMMENTS:		
	Is inventory data for MARCORSYSCOM PM AMMO reported to Sea Systems Command Detachment, Radiological Affairs Support Office by 31 January of each year captured and recorded for each DODIC that is assigned to a specific DU ammunition round?		
7	Ref: NRMP 45-67854-L1NP		
	DEFICIENCIES/COMMENTS:		
	RECEIPT, TRANSFER AND DISPOSAL OF RADIOACTIVE MATERIAL		
	Do commands maintain a copy of the currently approved version of DOT-SP 9649? Are shipments of DU ammunition marked and labeled in accordance with DOT-SP 9649?		
8	Ref: 49CFR, DOT-SP 9649		
	DEFICIENCIES/COMMENTS:		
	Are transfers and receipts of DU ammunition processed through OIS-MC for maintaining a current inventory of DU ammunition possessed by Naval and Marine Corps entities?		
9	MCO 8010.13		
-	DEFICIENCIES/COMMENTS:		

Is the disposal of any DU ammunition coordinated with the US Army for transfer to their custody? Are transfer records maintained by the affected command that made the actual transfer of DU ammunition for disposal or demilitarization? Ref: NRMP 45-67854-L1NP, MCO 8010.13 10 DEFICIENCIES/COMMENTS: DU ammunition receipt records. Do material receipt records at storage commands include the following information, at a minimum: a. A copy of the source procurement documentation (i.e., a DD Form 250, DD Form 1149, etc.,) identifying the radioactive material. b. A copy of the bill of lading or manifest for the shipment. c. The time of receipt and the radiation survey 11 corresponding to receipt of the radioactive material, under the conditions specified for when a receipt survey is required (damaged packaged). d. Receipt records shall be maintained indefinitely. Ref: NAVSEA S0420-AA-RAD-010 Section 2.26.10 DEFICIENCIES/COMMENTS: DU ammunition transfer records. Do material transfer records at storage commands contain the following information, at a minimum: a. A copy of documentation verifying that the receiving command or activity is licensed or authorized by a NRMP to receive the material. b. A copy of the bill of lading or manifest for the 12 shipment, if applicable. c. A copy of the material receipt acknowledgement of receipt from the receiving command or activity. d. Transfer records shall be maintained indefinitely. Ref: NAVSEA S0420-AA-RAD-010 Section 2.26.10

	DEFICIENCIES/COMMENTS:
13	Are records of DU ammunition shipments from the command maintained indefinitely after the shipment is made? Ref: NAVSEA S0420-AA-RAD-010 Section 2.22.2.18 DEFICIENCIES/COMMENTS:
14	Are DU ammunition storage areas posted with signage bearing the radiation trefoil symbol and stating "Caution-Radioactive Material", which is easily viewable by anyone entering the area? Ref: NAVSEA S0420-AA-RAD-010, Section 2.17.2 DEFICIENCIES/COMMENTS:
15	Are DU ammunition storage areas posted with signage bearing the radiation trefoil symbol and stating "Caution-Radiation Area" where radiation levels exceed two mrem/hour at 30 centimeters from the source of radiation or surface through which it penetrates? Is signage easily viewable by anyone entering the area? Ref: NAVSEA S0420-AA-RAD-010, Section 2.17.4 Appendix A, Glossary DEFICIENCIES/COMMENTS:
16	Do commands in possession of DU ammunition for storage purposes have security-restrictions on access and have appropriate physical security measures to ensure unauthorized individuals or members of the public do not gain access to DU ammunition? Ref: MCO 5530.14A, NAVSEA S0420-AA-RAD-010 DEFICIENCIES/COMMENTS:

	Are DU ammunition storage locations posted with current copies of the following:		
	a. Nuclear Regulatory Commission (NRC} Form 3, "Notice to Employees"		
	b. A copy of any notice of violation involving radiological working conditions, proposed imposition of civil penalty, any order by the NRC and any response to the violation.		
	Are the following either posted in the same location or is a notice posted that describes the document, including the name of the individual to whom reports may be made, and states where they may be examined?		
17	a. 10 CFR Parts 19, 20, 21 and 40		
	b. A current copy of NRMP 45-67854-L1NP		
	c. A copy of this instruction which contains the operating and emergency procedures applicable to the licensed activities		
	d. Section 206 of the Energy Reorganization Act of 1974		
	Ref: 10 CFR 19.11		
	Ref: 10 CFR 19.11 DEFICIENCIES/COMMENTS:		
	Ref: 10 CFR 19.11 DEFICIENCIES/COMMENTS:		
	Ref: 10 CFR 19.11 DEFICIENCIES/COMMENTS:		
	Ref: 10 CFR 19.11 DEFICIENCIES/COMMENTS:		
	Ref: 10 CFR 19.11 DEFICIENCIES/COMMENTS:		
	Ref: 10 CFR 19.11 DEFICIENCIES/COMMENTS: RADIATION SURVEY INSTRUMENTS	YES	NO
1.9	<pre>Ref: 10 CFR 19.11 DEFICIENCIES/COMMENTS:  RADIATION SURVEY INSTRUMENTS Do commands possess or, when necessary, have access to the types and quantities of radiation survey instruments to make accurate radiation measurements for protecting the health of individuals, demonstrating compliance with requirements, and taking actions to minimize adverse effects to the environment?</pre>	YES	NO
18	<pre>Ref: 10 CFR 19.11 DEFICIENCIES/COMMENTS:  RADIATION SURVEY INSTRUMENTS Do commands possess or, when necessary, have access to the types and quantities of radiation survey instruments to make accurate radiation measurements for protecting the health of individuals, demonstrating compliance with requirements, and taking actions to minimize adverse effects to the environment? Ref: NAVSEA S0420-AA-RAD-010. Section 2.12.1.1</pre>	YES	NO
18	<pre>Ref: 10 CFR 19.11 DEFICIENCIES/COMMENTS:  RADIATION SURVEY INSTRUMENTS Do commands possess or, when necessary, have access to the types and quantities of radiation survey instruments to make accurate radiation measurements for protecting the health of individuals, demonstrating compliance with requirements, and taking actions to minimize adverse effects to the environment? Ref: NAVSEA S0420-AA-RAD-010. Section 2.12.1.1 DEFICIENCIES/COMMENTS:</pre>	YES	NO
18	<pre>Ref: 10 CFR 19.11 DEFICIENCIES/COMMENTS:  RADIATION SURVEY INSTRUMENTS Do commands possess or, when necessary, have access to the types and quantities of radiation survey instruments to make accurate radiation measurements for protecting the health of individuals, demonstrating compliance with requirements, and taking actions to minimize adverse effects to the environment? Ref: NAVSEA S0420-AA-RAD-010. Section 2.12.1.1 DEFICIENCIES/COMMENTS:</pre>	YES	NO
18	<pre>Ref: 10 CFR 19.11 DEFICIENCIES/COMMENTS:  RADIATION SURVEY INSTRUMENTS Do commands possess or, when necessary, have access to the types and quantities of radiation survey instruments to make accurate radiation measurements for protecting the health of individuals, demonstrating compliance with requirements, and taking actions to minimize adverse effects to the environment? Ref: NAVSEA S0420-AA-RAD-010. Section 2.12.1.1 DEFICIENCIES/COMMENTS:</pre>	YES	NO
18	<pre>Ref: 10 CFR 19.11 DEFICIENCIES/COMMENTS:  RADIATION SURVEY INSTRUMENTS Do commands possess or, when necessary, have access to the types and quantities of radiation survey instruments to make accurate radiation measurements for protecting the health of individuals, demonstrating compliance with requirements, and taking actions to minimize adverse effects to the environment? Ref: NAVSEA S0420-AA-RAD-010. Section 2.12.1.1 DEFICIENCIES/COMMENTS:</pre>	YES	NO
18	Ref: 10 CFR 19.11 DEFICIENCIES/COMMENTS: RADIATION SURVEY INSTRUMENTS Do commands possess or, when necessary, have access to the types and quantities of radiation survey instruments to make accurate radiation measurements for protecting the health of individuals, demonstrating compliance with requirements, and taking actions to minimize adverse effects to the environment? Ref: NAVSEA S0420-AA-RAD-010. Section 2.12.1.1 DEFICIENCIES/COMMENTS: Are Radioactivity Detection, Indication, and Computation instrument inventory, calibration, and response check records maintained for three years?	YES	NO
18	<pre>Ref: 10 CFR 19.11 DEFICIENCIES/COMMENTS:  RADIATION SURVEY INSTRUMENTS Do commands possess or, when necessary, have access to the types and quantities of radiation survey instruments to make accurate radiation measurements for protecting the health of individuals, demonstrating compliance with requirements, and taking actions to minimize adverse effects to the environment? Ref: NAVSEA S0420-AA-RAD-010. Section 2.12.1.1 DEFICIENCIES/COMMENTS: Are Radioactivity Detection, Indication, and Computation instrument inventory, calibration, and response check records maintained for three years? Ref: NAVSEA S0420-AA-RAD-010, Sections 2.12.2.3, 2.26.9</pre>	YES	NO
18	<pre>Ref: 10 CFR 19.11 DEFICIENCIES/COMMENTS:  RADIATION SURVEY INSTRUMENTS Do commands possess or, when necessary, have access to the types and quantities of radiation survey instruments to make accurate radiation measurements for protecting the health of individuals, demonstrating compliance with requirements, and taking actions to minimize adverse effects to the environment? Ref: NAVSEA S0420-AA-RAD-010. Section 2.12.1.1 DEFICIENCIES/COMMENTS: Are Radioactivity Detection, Indication, and Computation instrument inventory, calibration, and response check records maintained for three years? Ref: NAVSEA S0420-AA-RAD-010, Sections 2.12.2.3, 2.26.9 DEFICIENCIES/COMMENTS:</pre>	YES	NO
18	Ref: 10 CFR 19.11 DEFICIENCIES/COMMENTS: RADIATION SURVEY INSTRUMENTS Do commands possess or, when necessary, have access to the types and quantities of radiation survey instruments to make accurate radiation measurements for protecting the health of individuals, demonstrating compliance with requirements, and taking actions to minimize adverse effects to the environment? Ref: NAVSEA S0420-AA-RAD-010. Section 2.12.1.1 DEFICIENCIES/COMMENTS: Are Radioactivity Detection, Indication, and Computation instrument inventory, calibration, and response check records maintained for three years? Ref: NAVSEA S0420-AA-RAD-010, Sections 2.12.2.3, 2.26.9 DEFICIENCIES/COMMENTS:	YES	NO

	TRAINING	YES	NO
	Are personnel properly trained in the handling and storage of DU ammunition prior to performing first-time operations with the DU ammunition? This shall also include any special precautions and instructions that pertain to ordnance safety.		
20	Ref: NAVSEA OP-4 (Ships}, NAVSEA OP-5 (Shore}, MCO 8023.3		
	Are members of the public and other organizational personnel working in proximity to DU ammunition storage areas provided a training brief?		
21	Ref: NAVSEA S0420-AA-RAD-010, Section 2.8.7		
	Deficiencies/Comments:		
	training records provided by the DU ammunition storage commands?		
2.2	Ref: NAVSEA S0420-AA-RAD-010, Sections 2.8, 2.26.5		
22	DEFICIENCIES/COMMENTS:		
	Do records of training identify the training date {s}, course subject matter (i.e., a brief description of the subjects covered), length of training, student test scores (if applicable), instructor name(s) and attendee name(s)?		
	Ref: NAVSEA S0420-AA-RAD-010, Sections 2.8, 2.26.5		
23	DEFICIENCIES/COMENIS.		

	RASP DEFICIENCY REPORTING	YES	NO
	Have RASP deficiencies identified during evaluations, inspections, reviews, and audits entered into the Radiological Deficiency Report {RDR) process to determine root cause (as applicable) and needed corrective actions? Are RDRs closed as corrective actions are implemented and have corrective actions taken been effective?		
24	Ref: NAVSEA S0420-AA-RAD-010, Sections 2.9.1.6.i, 2.9.2, and 2.11		
	DEFICIENCIES/COMMENTS:		
	RADIATION AND CONTAMINATION SURVEY RECORDS	YES	NO
	Are contamination surveys being conducted:		
	a. As required during the receipt and shipment of DU ammunition?		
	b. As required for emergency actions to prevent the spread of contamination?		
25	Ref: 49 CFR		
	DEFICIENCIES/COMMENTS:		
	Are radiation surveys being conducted:		
	a. Monthly in occupied radioactive material storage areas and areas adjacent to these areas?		
26	b. Annually in unoccupied radioactive material storage areas?		
	c. As required for the shipment of DU ammunition?		
	Ref: NAVSEA S0420-AA-RAD-010, Section 2.21.2. 49 CFR		

	DEFICIENCIES/COMMENTS:				
	REVIEW OF RDRS AND TREND ANALYSIS		YES	NO	
	List all RDR's generated since the las	t semi-annual radiation			
	protection audit associated with NRMP	13-00164-L1NP:			
	DD Social Number:	Data			
	RDR Serial Number:	Date:			
	RDR Serial Number:	Date:			
	RDR Serial Number:	Date:			
	RDR Serial Number:	Date:			
	RDR Serial Number:	Date:			
27					
	RDRs listed above:	ed on the review of the			
	Ref: NAVSEA S0420-AA-RAD-010, Section	2.9.1.7			
	DEFICIENCIES/COMMENTS:				

Audit Performed by: \_\_\_\_\_(Signature)

Date:\_\_\_\_\_

Reviewed by Commanding Officer: \_\_\_\_\_\_ (Signature)

Date:\_\_\_\_\_

# Appendix C

# RADIOLOGICAL AFFAIRS SUPPORT PROGRAM (RASP) AUDIT PROGRAM CHECKLIST FOR NAVAL RADIOACTIVE MATERIALS PERMIT (NRMP) 45-67854-L1NP FOR DEPLETED URANIUM (DU) STORAGE COMMANDS

	AUDIT ATTRIBUTE	YES	NO	
	Does the Command have the latest copies of NRMP 45-67854-L1NP and RASP program instruction? (List Below)			
	NRMP 45-67854-L1NP, Amendment No.:			
	MCO No.:			
1	Ref: NRMP 45-67854-L1NP			
	DEFICIENCIES/COMMENTS:			
	Does the Command maintains current copies of:			
	a. 10CFR, Parts 19, 20, 21, 40 and 71			
	b. 49CFR, Parts 171-180			
	c. NAVMED P-5055			
	d. NAVSEA S0420-AA-RAD-010			
	e. DOT-SP 9649			
	f. NAVSEA OP-4 (Ships)			
	g. NAVSEA OP-5 (Shore)			
	h. NAVSEA SW020-AC-SAF-010			
2	i. MCO 8010.13			
	j. NOSSA Web site ttps://nossa.nmci.navy.mil/nrws3/Home.aspx)			
	k. Marine Ammunition Knowledge Enterprise web site (https://www.make.usmc.mil/Auth/login.aspx)			
	Demonstration of internet access is acceptable			
	Ref: NRMP 45-67854-L1NP			
	DEFICIENCIES/COMMENTS:			

	Does the Responsible Individual (RI) maintain records and documentation that demonstrate compliance with NRMP conditions?		
	Ref: NAVSEA S0420-AA-RAD-010, Sections 1.5.2.r and 2.9.1.6		
3	DEFICIENCIES/COMMENTS:		
	Does the Command only possess DU ammunition authorized by the NRMP and only conducts those processes that are authorized by the NRMP? Ref: NRMP 45-67854-L1NP		
4	DEFICIENCIES/COMMENTS:	1	
	Has the Command (Shore/Afloat) designated a Responsible Individual (RI) for addressing the radiological safety requirements and radiological aspects of DU munitions? Name of RI:		
5	Ref: NAVSEA S0420-AA-RAD-010, Section 2.24.2		
	DEFICIENCIES/COMMENTS:		
6	Is DU ammunition located and used in a manner that keeps radiation doses to members of the public below 100 mRem per year? In addition, is DU ammunition stored in a manner so that members of the public are not exposed to radiation dose rates exceeding two mrem per hour?		
	Ref: NAVSEA S0420-AA-RAD-010, Section 2.24.2		
	DEFICIENCIES/COMMENTS:	Ι	
7	DU ammunition receipt records. Do material receipt records at storage commands include the following information, at a minimum:		

a. A copy of the source procurement documentation (i.e., a DD Form 250, DD Form 1149, etc.,) identifying the radioactive material.

b. A copy of the bill of lading or manifest for the shipment.

c. The time of receipt and the radiation survey corresponding to receipt of the radioactive material, under the conditions specified for when a receipt survey is required (damaged packaged).

d. Receipt records shall be maintained indefinitely.

Ref: NAVSEA S0420-AA-RAD-010 Section 2.26.10

DEFICIENCIES/COMMENTS:

DU ammunition transfer records. Do material transfer records at storage commands contain the following information, at a minimum:

a. A copy of documentation verifying that the receiving command or activity is licensed or authorized by an NRMP to receive the material.

b. A copy of the bill of lading or manifest for the shipment, if applicable.

c. A copy of the material receipt acknowledgement of receipt from the receiving command or activity.

d. Transfer records shall be maintained indefinitely.

Ref: NAVSEA S0420-AA-RAD-010 Section 2.26.10

DEFICIENCIES/COMMENTS:

9

Are DU ammunition storage areas posted with signage bearing the radiation trefoil symbol and stating "Caution-Radioactive Material", which is easily viewable by anyone entering the storage area?

Ref: NAVSEA S0420-AA-RAD-010, Section 2.17.2

DEFICIENCIES/COMMENTS: Are DU ammunition storage locations posted with current copies of the following: a. Nuclear Regulatory Commission (NRC} Form 3, "Notice to Employees" A copy of any notice of violation involving b. radiological working conditions, proposed imposition of civil penalty, any order by the NRC and any response to the violation. Are the following either posted in the same location or is a notice posted that describes the document, including the name of the individual to whom reports may be made, and states where they may be examined? 10 10 CFR Parts 19, 20, 21 and 40 a. b. A current copy of NRMP 45-67854-L1NP c. A copy of this instruction which contains the operating and emergency procedures applicable to the licensed activities d. Section 206 of the Energy Reorganization Act of 1974 Ref: 10 CFR 19.11 DEFICIENCIES/COMMENTS: Do commands in possession of DU ammunition for storage purposes have security-restrictions on access and have appropriate physical security measures to ensure unauthorized individuals or members of the public do not gain access to DU ammunition? 11 Ref: MCO 5530.14A, NAVSEA S0420-AA-RAD-010 DEFICIENCIES/COMMENTS:

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	Does the command possess or, when necessary, have access to the types and quantities of radiation survey instruments to make accurate radiation measurements for protecting the health of individuals, demonstrating compliance with requirements, and taking actions to minimize adverse effects to the environment?		
	{RADIAC) Models and Serial Numbers:		
	Model Serial Number		
12	1.		
	2.		
	3.		
	4.		
	Ref: NAVSEA S0420-AA-RAD-010, Section 2.12.1.1		
	DEFICIENCIES/COMMENTS:		
		·	
	Does the RI ensure an annual inventory of the Command's DU ammunition is performed and reported through the OIS-MC? When any change occurs to the DU inventory held at the Command, is the transaction reported immediately in OIS-MC?		
13	Date of Inventory:		
	Ref: NAVSEA S0420-AA-RAD-010, Section 9.3.3.4.f, MCO 8020.13		
	DEFICIENCIES/COMMENTS:		

	Have all personnel, assigned first-time duties in the handling and storage of DU ammunition, received non-radiation worker training as provided by or approved by the MARCORSYSCOM RSO?		
14	Ref: NAVSEA S0420-AA-RAD-010, Section 2.8.6		
	DEFICIENCIES/COMMENTS:		
	Are members of the public and other organizational personnel working in proximity to DU ammunition storage areas provided a training brief?		
15	Ref: NAVSEA S0420-AA-RAD-010, Sections 2.8.7, 2.26.5		
	DEFICIENCIES/COMMENTS:		
		,	
	Do records of local initial training identify the training date {s}, course subject matter (i.e., a brief description of		
	the subjects covered), length of training, student test		
	name(s)? Have copies of all training been provided to the		
	MARCORSYSCOM RSO?		
16			
	Ref: NAVSEA S0420-AA-RAD-010, Sections 2.8, 2.26.5		
	Are contamination surveys being conducted.	<u> </u>	
	Are contamination surveys being conducted.		
	a. As required during the receipt and shipment of DU ammunition?		
	b. As required for emergency actions to prevent the spread of contamination?		
17	Ref: 49 CFR		
	DEFICIENCIES/COMMENTS:		

 Are radiation surveys being conducted:
 a. Monthly in occupied radioactive material storage areas and areas adjacent to these areas?
 b. Annually in unoccupied radioactive material storage areas?

 18
 c. As required for the shipment of DU ammunition?
 c.

 18
 Ref: NAVSEA S0420-AA-RAD-010, Section 2.21.2. 49 CFR
 DEFICIENCIES/COMMENTS:

Audit Performed by:		(Signature)
Date:		
Command:	UIC/RUC:	
Reviewed by RSO:		_(Signature)
Date:		

## Appendix D

#### AN/PDQ-4 RADIAC Set Technical Basis

1. Technical Basis for Proposed Detector Efficiency AN/PDQ-4 RADIAC set for reference (a) DU Ammunition.

## a. AN/PDQ-4 (or equivalent) RADIAC Set

(1) The AN/PDQ-4 (or equivalent) RADIAC Set consists of the IM-265/PDQ RADIAC meter, a Beta Probe Interface DT-685/PDQ, a DT-304/PDR beta probe, and other ancillary equipment. The range of the AN/PDQ-4 RADIAC Set is zero to 50,000 CPM with sensitivity for beta radiation (energies that are greater than 40 keV) and for gamma radiation. The DT-304/PDR beta probe attached to the AN/PDQ-4 RADIAC Set is an industry standard Geiger-Mueller (GM) "pancake" detector that can detect alpha, beta, and gamma radiation.



(2) EE700-AD-MM0-010, "Technical Manual Operation Instructions Organization Maintenance Multifunction RADIAC Sets and Ancillary Probes/Interfaces" and EE730-AB-MM0-010, "Technical Manual Operation and Maintenance Instruction Organizational and Intermediate Maintenance Level" provides for beta efficiency (with protective grid) of six percent (0.06) for Carbon-14. From EE700-AD-MM0-010, this efficiency determination was made with the source at approximately one centimeter (cm) from the detector. EE700-AD-MM0-010 also provides these beta efficiencies (with protective grid), as a percentage of the 4Pi emission rate, with the calibration standards placed completely under the active detector area:

137Cs:  $E_{max}$  = 1.167 MeV (at 0.95 probability of decay) = 22% (0.22)

 $^{60}$ Co:  $E_{max} = 1.478$  MeV (at 1.0 probability of decay) = 16% (0.16)

90Sr-90Y: E<sub>max</sub> = 544 keV for 90Sr & E<sub>max</sub> = 2. 245 MeV for 90Y, (at 1.0 probability of decay) = 32% (0.32)

 $^{99}$ Tc:  $E_{max}$  = 295 keV (at 1.0 probability of decay) = 15% (0.15)

(3) EE730-AB-MM0-010 provides that the AN/PDQ-4 RADIAC Set provides for an energy response of +/- 15% for 40 keV and higher energies when using the Beta Probe Interface, DT-685/PDQ equipped with the DT-304/PDR beta probe. DU has principle decay products with average beta energies of 515 keV (Pa-234m) and 0.046 keV (Th-234), and DU and associated decay products have alpha energies in excess of four MeV. Steinmeyer (Radiation Safety Officer Magazine Volume 10, No. 5, 2005) suggests that for < three MeV alphas, a GM probe can detect at 15% efficiency (4Pi source geometry with source of activity completely under the detector, at one cm from the source of activity). MARCORSYSCOM proposes a detection efficiency of 0.10 (10%) when monitoring for DU contamination using the AN/PDQ-4 RADIAC Set (conservative and consistent with the recommendations of DOT 49 CFR 173.443 for package surveys). The use of 0.10 as the detection efficiency for the AN/PDQ-4 RADIAC Set is likely to overestimate contamination levels from actual values, but will be conservative with regards to reporting as to not underestimate the contamination levels; consideration was not given to detection efficiencies for various surface types that may be encountered (i.e., porous concrete), so the use of this lower efficiency value (0.10) should counter any over-estimates of the contamination levels. Contamination surveys applying this detector efficiency will be performed at approximately one cm from the surface at a scan rate of no more than two inches per second. When an increase in the audible response ("click-rate") is detected or an increase in the observed count-rate is observed, the surveyor shall pause for at least one minute to ensure a stable and accurate reading on the RADIAC meter. Contamination surveys shall be performed by direct scan, with the results normalized to DPM/100cm<sup>2</sup> by factor of 6.67 (100 cm<sup>2</sup>/15 cm<sup>2</sup>) to account for the area of the detector window. All Contamination survey results (i.e. for swipe samples, package surfaces, area work surfaces) shall be normalized to DPM/100  $cm^2$  for comparison to the limits of reference (c), Table 2-2.

# b. <u>Minimum Detectable Activity (MDA) for Radioactivity Detection,</u> <u>Indication and Computations (RADIACs) Used; Comparison of MOA with</u> <u>Contamination Limits</u>

(1) The MDA for a specific RADIAC is a calculated value that corresponds to the Critical Level (Lc) for reaching a decision of no detection of signal if the actual net counts are less than Lc and detection if the actual counts are larger than Lc. The Lc is a decision limit that is used for comparison against surface contamination limits and it is used for demonstrating that contamination is not present above the Lc. Accurate determinations of an MDA, for scanning with portable survey instruments, is inherently prone to variability and error that results from instrument response time, surface geometry, scan speeds, and surveyor technique. For this reason, the surveyor will listen audibly for a discernible increase in the count rate (audible clicks) while observing meter response for any upscale deflection. If an increase in count rate is suspected, the surveyor will stop the scanning process and perform a static count in the suspect area for at least one minute. This will allow for a time period that exceeds response time for the instrument in use.

(2) The *Lc* is a function of the observed background count rate. Background determinations shall be made over a period of at least one minute to ensure the meter has stabilized, for increased accuracy of the background determination. Application of the *Lc* will apply to static measurements of the duration of at least one minute using detectors of known efficiencies for the radionuclide(s) of interest. Measurements will be made at a distance of approximately one cm from the surface under survey. When performing a direct scan survey, the detector shall be moved over the surface at no more than one to two inches per second, at one cm from the surface. If a detectable increase in the meter reading and/or a detectable increase in the audible count-rate are observed, the one-minute static measurement shall then be performed.

c. Minimum Detectable Activity (MDA) Determinations (Beta-Gamma):

 $MDA_{(direct \ scan)} = \frac{4.65 * (B/2t_c)^{1/2}}{E * (A/100 \text{cm}^2)}$ 

Where:

Lc = DPM/100 cm2 and is the net number of counts (total minus background) for reaching a decision of no detection of signal if the actual net counts are less than Lc (direct scan) and detection if the actual counts are larger than Lc (direct scan).

B = "True" background count in an interval of time (i.e. CPM)

E = Detection efficiency (CPM/DPM) of the meter

A = Effective area of the beta-gamma probe  $(15 \text{ cm}^2)$ 

NOTE: For the purposes of the calculation, "counts" per unit time, or "counts" over an interval of time, are unit-less.

$$L_{c (swipe sample)} = \frac{2.32 * (B)^{1/2}}{E}$$
  
Where:

Lc = DPM; the net number of counts (total minus background) for reaching a decision of no detection of signal if the actual net counts are less than Lc (direct scan) and detection if the actual counts are larger than Lc (direct scan).

B = "True" background count in an interval of time (i.e. CPM)

E = Detection efficiency (CPM/DPM) of the meter

NOTE: For the purposes of the calculation, "counts" per unit time, or "counts" over an interval of time, are unit-less.

d. <u>Alternate Minimum Detectable Activity (MDA) Determinations (Beta-</u> <u>Gamma)</u>

(1) From NUREG/CR-5849, Equation 5-3 (KNOLL 1979, NCRP 58), the MDA can be determined from:

$$MDA_{(direct \ scan)} = \frac{4.65 * (B/2t_c)^{1/2}}{E * (A/100 \text{cm}^2)}$$

Where:

 $MDA = DPM/100 \text{ cm}^2$  (total minus background) for reaching a decision of no detection of signal if the actual net counts are less than MDA and detection if the actual counts are larger than MDA.

B = Background count-rate (CPM)

 $t_c$  = Meter time constant in minutes ( $t_c$  may also be referred to as "response time"); if this information is available for the RADIAC in question.

E = Detection efficiency (CPM/DPM) of the meter

A = Active probe area in  $cm^2$ : 100 for field count of swipes, do not use the "(A/100 $cm^2$ )" factor as the swipe will be completely under the detector.

Example 1: A removable contamination survey is performed on a DU package prepared for transportation, over an area of  $300 \text{ cm}^2$ , on the surface of the package. A background count rate of 40 CPM is observed using the AN/PDQ-4 RADIAC Set. The detector of the AN/PDQ-4 RADIAC Set is placed at one cm from the swipe sample ("dry smear"). The AN/PDQ-4 RADIAC Set meter indicates 45 CPM (gross count) at one cm from the swipe sample (collected over a 300 cm<sup>2</sup> area), with the swipe sample positioned completely under the detector. The activity of contamination on the package is determined from:

 $\frac{\text{CPM}_{(\text{gross count})} - \text{CPM}_{(\text{background})}}{\text{Detector Efficiency} \quad (\text{CPM/DPM})} = \frac{45-40}{0.10} = 50 \text{ DPM}$ 50 DPM/300 cm<sup>2</sup> equates to 17 DPM/100 cm<sup>2</sup>

(2) Determine the decision limit, *Lc*, when there is any observed count-rate that is discernible from background (attributable to contamination). The *Lc* determination will be made for comparison against contamination limits of reference (b), Table 2-2.

 $L_{c \ (swipe \ sample)} = \frac{2.32 * (40)^{1/2}}{0.10 \ \text{CPM/DPM}} = 150 \ \text{DPM}$ 

The  $L_c$  (swipe sample) of 150 DPM (divided by 3 = 50 DPM/100 cm<sup>2</sup>) is less than the removable alpha and beta-gamma contamination limits provided in 49 CFR 173.443 and reference (c), Table 2-2, for DU. Therefore, no contamination controls are required and there is no impact to shipment of this package.

Example 2: A background count rate of 30 CPM is observed using the AN/PDQ-4 RADIAC Set. In the performance of an incident contamination survey of DU ammunition use areas, a direct scan of a work surfaces measures 50 CPM (gross count) at one cm, using the AN/PDQ-4 RADIAC Set. The activity of contamination on the affected surface is determined from:

 $\frac{\text{CPM}_{(\text{gross count})} - \text{CPM}_{(\text{background})}}{\text{Detector Efficiency} \quad (\text{CPM}/\text{DPM})} * 6.67 = \frac{50-30}{0.10} * 6.67 = 1,334 \text{ DPM}/100 \text{ cm}^2$ 

Since 1,334 DPM/100 cm2 (by direct scan) is greater than the values of reference (c), Table 2-2 for removable contamination, a swipe sample would be collected and measured as discussed in example 1. For this example, we determined the activity on the swipe sample to have net activity of "0 DPM/100 cm<sup>2</sup>", as there was no activity present that was discernible from background. If there is detectable activity and the *Lc* or the measure of activity on the swipe sample were to exceed the values of reference (c), Table 2-2, for removable contamination, the contamination control measures of reference (c), Section 2.20, would be implemented and immediate notifications required by reference (c), Section 2.23, would be made by the RSO.

$$L_{c}(direct \ scan) = \frac{2.32 \ * \ (30)^{\frac{1}{2}}}{0.10 \frac{\text{CPM}}{\text{DPM}} \ * \ \left(\frac{15 \ \text{cm}^{2}}{100 \ \text{cm}^{2}}\right)} = 850 \ \text{DPM}$$

The  $L_c(direct \ scan)$  of 850 DPM is less than the contamination limits of reference (c), Table 2-2, for beta-emitters (except for Sr-90). The activity value of 1,334 DPM/100 cm<sup>2</sup> that was determined to be present by direct scan is within the contamination limits of reference (c), Table 2-2, for total (fixed plus removable) contamination. No further action for contamination control is required. However, the source of elevated radioactivity should be removed by appropriate and authorized means.

e. Monitoring of Surface Areas Less Than 100 cm<sup>2</sup>. For the survey of surface areas that are less than 100 cm<sup>2</sup>, the contamination levels detected and applicable lower limits of detection will be normalized to DPM/100 cm<sup>2</sup>, with correction factors that take into account the actual surface area surveyed.

f. <u>Technical Basis References</u>. References, (b), (i), and National Council on Radiation Protection and Measurements Report 58 were used in the development of this technical basis.

g. <u>Contamination Limits</u>. Table 1 of this appendix provides the surface contamination limits, reproduced from reference (c), Table 2-2.

NUCLIDE	FIXED PLUS	REMOVABLE	
U-nat, U-235, U-238 and associated decay products, alpha emitters.	5000 dpm/100 cm2	15000 dpm/100 cm2	1000 dpm/100 cm2
Transuranics, Ra-226, Ra-228, Th- 230, Th-228, Pa-231, Ac-227, I-125, I- 129	100 dpm/ 10 0 cm2	300 dpm/100 cm2	20 dpm/ 100 cm2
Th-nat, Th-232, Sr- 90, Ra-223, Ra- 224,U-232, I-126, I-131, I-133	1000 dpm/100 cm2	3000 dpm/ 100 cm2	200 dpm/ 100 cm2
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission)except Sr-90 and others noted above(see Note 1).	5000 dpm/ 100 cm2	15000 dpm/ 100 cm2	1000 dpm/100 cm2

Table D-1.--Surface Contamination Limits

## Note:

1. This category of radionuclides includes mixed fission products, including the Sr-90, which is present in them. It does not apply to Sr-90, which has been separated from other fission products or mixtures where the Sr-90 has been enriched.

General Notes

1. Where surface contamination by both alpha and beta-gamma emitting nuclides exist, the limits established for alpha and beta-gamma nuclides apply independently.

2. As used in this table, DPM means the rate of emission by radioactive material determined by correcting the CPM observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrument.

3. Measurements of average contamination should not be determined over more than one square meter. For objects with less surface area, the average should be derived for each object.

4. The maximum contamination level applies to an area of not more than 100  $\mbox{cm}^2.$ 

5. The amount of removable radioactive material per 100cm<sup>2</sup> of surface area should be determined by wiping that area with dry filter paper or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of less surface area is determined, the entire surface area should be wiped and pertinent contamination levels should be reduced proportionally. Except for transuranic and Ra-226, Ra-228, Ac-227, Th-228, Th-230, and Pa-231 alpha emitters, it is unnecessary to use wiping techniques to measure removable contamination levels if direct scan surveys indicate that total residual surface contamination levels are within the limits for removable contamination.

6. The average and maximum radiation levels associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mR/hr at one cm (average) and 1.0 mR/hr at one cm (maximum), respectively, measured through not more than seven milligrams per square centimeter of total absorber.