Impact of Depleted Uranium and Other Radioactive Materials on Military Range Operations
Overview

- Introduction
- Radioactive Material on Ranges
- Relative and Perceived Risk
- Operational Impacts
- Regulatory Impacts
- Logistical Impacts
- Summary
Introduction

Purpose: to generally define the nature and extent of radioactive material on ranges and to provide some insight into the relative risks and impacts on sustainment and remediation operations

- Is radioactive material (RAM) on DoD munitions ranges a significant concern to range sustainment and remediation operations?
  - Identification
    - Define nature and extent
  - If RAM is of concern, to what degree and will it influence Range Sustainment and MMRP-supported initiatives?
    - Significance
      - Relative risk or perceived risk as a driver
      - Operational impacts
      - Regulatory impacts
      - Logistical impacts
Sources of Radioactive Material on Ranges

- **Direct Sources**
  - Air-to-Ground firings
  - Ground-to-Ground firings
  - Test and Evaluation
  - Research and Development

- **Indirect Sources**
  - Ground based range targets and components
  - Aerial range targets
  - Launch vehicle accidents
  - Aircraft accidents
  - Range maintenance activities
Radioactive Material on Ranges – Direct Sources

Direct Operational Sources for RAM on Ranges
- DU Munitions Training
  - Air-to-surface
  - Surface-to-surface
- Test and Evaluation
  - DU munitions
  - DU joint test assemblies
- Other
  - Nuclear effects testing
  - Foreign intelligence
Radioactive Material on Ranges

- Direct Sources (cont)

- **DU-Containing Direct Attack Munitions**
  - Penetrator rounds
    - 20mm MK149
    - 25mm PGU-20
    - 30mm PGU-14/B API
  - Sabot Rounds
    - 25mm M919 APFSDS-T
    - 120mm M829 APFSDS-T

- **Other DU-Containing Munitions**
  - Spotter rounds
  - Mines
  - Foreign systems
# Selected DU Ammunition in the U.S. Arsenal

<table>
<thead>
<tr>
<th>Ammunition type</th>
<th>Cal. [mm]</th>
<th>Mass [lb.]</th>
<th>Mass [g]</th>
<th>Weapons system</th>
<th>Branch</th>
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<tbody>
<tr>
<td>M829A1, M829A2 (APFSDS-T)</td>
<td>120</td>
<td>11.8</td>
<td>5,350</td>
<td>M1A1, M1A2 Abrams Tanks</td>
<td>US Army, US Marine Corps</td>
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<td>M900 (APFSDS-T)</td>
<td>105</td>
<td>9.4</td>
<td>4,246</td>
<td>M1 Abrams Tank</td>
<td>US Army</td>
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<td>M833 (APFSDS-T)</td>
<td>105</td>
<td>8.1</td>
<td>3,668</td>
<td>M60A3 Tank</td>
<td>obsolete</td>
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<tr>
<td>M774 (APFSDS-T)</td>
<td>105</td>
<td>7.4</td>
<td>3,355</td>
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<tr>
<td>PGU-14 (API)</td>
<td>30</td>
<td>0.66</td>
<td>298</td>
<td>A-10 Thunderbolt II Aircraft (same as A-10 Warthog Aircraft)</td>
<td>US Air Force</td>
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<tr>
<td>M919 (APFSDS-T)</td>
<td>25</td>
<td>0.21</td>
<td>97</td>
<td>M2, M3 Bradley Fighting Vehicles</td>
<td>US Army, US Marine Corps</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>LAV-AT Light Armored Vehicle</td>
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<tr>
<td>PGU-20 (API)</td>
<td>25</td>
<td>0.33</td>
<td>148</td>
<td>MK-38 Heavy Machine Gun</td>
<td>US Navy, US Marine Corps</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>AV-8B Harrier II Aircraft</td>
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<tr>
<td>MK149-2 (APDS)</td>
<td>20</td>
<td>0.15</td>
<td>70</td>
<td>Phalanx CIWS Missile Defense Gun</td>
<td>US Navy</td>
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APFSDS-T: Armor Piercing Fin Stabilized Discarding Sabot with Tracer  
APDS-T: Armor Piercing Discarding Sabot with Tracer  
APDS: Armor Piercing Discarding Sabot  
API: Armor Piercing Incendiary
Radioactive Material on Ranges – Indirect Sources

Indirect Sources for RAM on Ranges
- Range Targets Containing RAM
  - Radio-luminescent components
  - MgTh high-temperature alloys
  - DU Counter-weights
- Aircraft/Missile/Drone/JTA Accidents
  - Sensors and electronics (electron tubes, targeting pods, etc.)
  - Assorted types of RAM
- Burial Sites
- Open Burn/Open Detonation (OB/OD) Sites
Radioactive Material on Ranges - Indirect Sources (cont)

- Radio-Luminescent Parts and Systems
  - Radioactive materials: Ra-226, Pm-147, Tritium (H-3)
  - Sources: dials and gauges, aim sights, breakers, etc.

- Other
  - Burial of accident and test bed debris
  - Nuclear testing fallout debris
  - Training for operations in a nuclear environment
Risk of Radioactive Material on Ranges
- Real and Perceived
Risk of RAM on Ranges

Relative Risk

- Typical active DU ranges are in the 1E-2 to 1E-4 cancer morbidity risk range for unrestricted future uses
  - Concentrations in the range of 10s-1000s of pCi/g
  - NRC Screening Level for U-238 (~1e-4 risk): 11 pCi/g
- Indirect RAM sources range from 1E-2 to 1E-8
  - Radium
    - EPA Residential PRG (1e-6 risk): 0.0124 pCi/g
    - Background range: 0.5-2.0 pCi/g
    - Single Radium Dial: ~500 pCi/g (B-29 had ~200/aircraft)
- Risk of mortality on active ranges from munitions span from near certain death to very low risk
Perceived Risk

- Military Toxics Project Information Sheet – June 2003 (first version)
  - "Depleted" Uranium Munitions: Nuclear Waste as a Weapon

**POISON DUST**

A NEW LOOK AT U.S. RADIOACTIVE WEAPONS

"Poison DUst includes a powerful indictment of past U.S. use of radioactive weapons.... "

banuraniumweapons

www.cadu.org.uk
Risk of RAM on Ranges

Perceived versus Actual Risk

- Actual/Relative risk may be significant and can independently drive remedial action
- Perceived risk is often greater than actual risk, but not always
- Perceived risk may dominate regulatory and other stakeholder concerns
- Perceived risk may independently drive action
Impact of RAM on Range Operations

- Operational
- Regulatory
- Logistical
Operational Impact

- **Health and Safety**
  - Need to include radioactive material exposure in health and safety plans

- **Personnel Training and Monitoring**
  - May need to provide radiation safety training, personnel protective equipment, and personnel monitoring

- **Environmental Compliance Monitoring**
  - May need to monitor airborne releases and surface water discharge
Internal Regulatory Drivers (DoD)

- Air Force & Navy possess Master Material Licenses issued by the Nuclear Regulatory Commission (NRC) for Source, SNM, and Byproduct
  - Air Force Radioisotope Committee
  - Navy RASO
- Army installations have separate commodity and use licenses issued by the NRC/Agreement States and managed both locally and centrally
- All services may possess/use Section 91b of Atomic Energy Act exempt materials
  - Nuclear weapons related radioactive materials
  - Defense-related nuclear reactors
  - Navy propulsion reactors
External Regulatory Drivers

- Atomic Energy Act (AEA)
- Clean Air Act (CAA)
- Toxic Substances Control Act (TSCA)
- Nuclear Waste Policy Act (NWPA)
- Low-Level Radioactive Waste Policy Act (LLRWPA)
- Safe Drinking Water Act (SDWA)
- Uranium Mill Tailings Radiation Control Act (UMTRCA)
- National Emissions Standards for Hazardous Air Pollutants (NESHAPS)
- Resource Conservation and Recovery Act (RCRA)
- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)
Logistical Impacts

► Range Sustainment
  - Air and water monitoring (EPA/States)
  - Source material licensing (NRC/States)
  - Personnel exposure protection and monitoring (NRC/OSHA/States)

► Range Remediation
  - D&D licensing (NRC/States)
  - Waste treatment and processing (EPA/NRC/States)
  - Waste transportation (NRC/DOT/States)
  - Waste disposal (DODEA/Regional Compacts/NRC/EPA/States)
Case Study:
Kirtland AFB Test and Evaluation Range
Kirtland AFB Test and Evaluation Range

- Static WWII era aircraft used weapons effects testing
- Most aircraft contained radium and thorium parts and components
- Radioactive material was deposited locally at the impact points and in burn/slag pits
- RW-068 Remediation Project ongoing
Case Study: Lake City AAP Firing Range
## Lake City AAP Hydro-cutting

<table>
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<tr>
<th></th>
<th>Potential HE</th>
<th>DU</th>
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<tbody>
<tr>
<td>Generated 2001</td>
<td>482</td>
<td>118</td>
</tr>
<tr>
<td>Generated 2002</td>
<td>137</td>
<td>22</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>619</strong></td>
<td><strong>140</strong></td>
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- **Hydro-Cut**
  - 409 (66%) 
  - 82 (59%)

- **Cleared**
  - 210 (34%)
  - 58 (41%)
Summary

- Radioactive Material (RAM) is prevalent on many ranges
  - Should be considered a potential contaminant of concern for range remediation operations
- Radioactive Material on ranges may present complex operational, regulatory, and logistical impacts
  - Health and safety plans, sampling and analysis plans, personnel/environmental monitoring, and compliance permitting/licensing may need to consider RAM
- The Risk of RAM may or may not drive an operational or remedial action, but it should be evaluated
  - Whether perceived or actual, the risk of RAM often drives some action during range sustainment and remediation operations
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