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Use of Snow-Covered Ranges to Estimate the Amounts of Residues Produced by High-Order Detonations

Thomas F. Jenkins

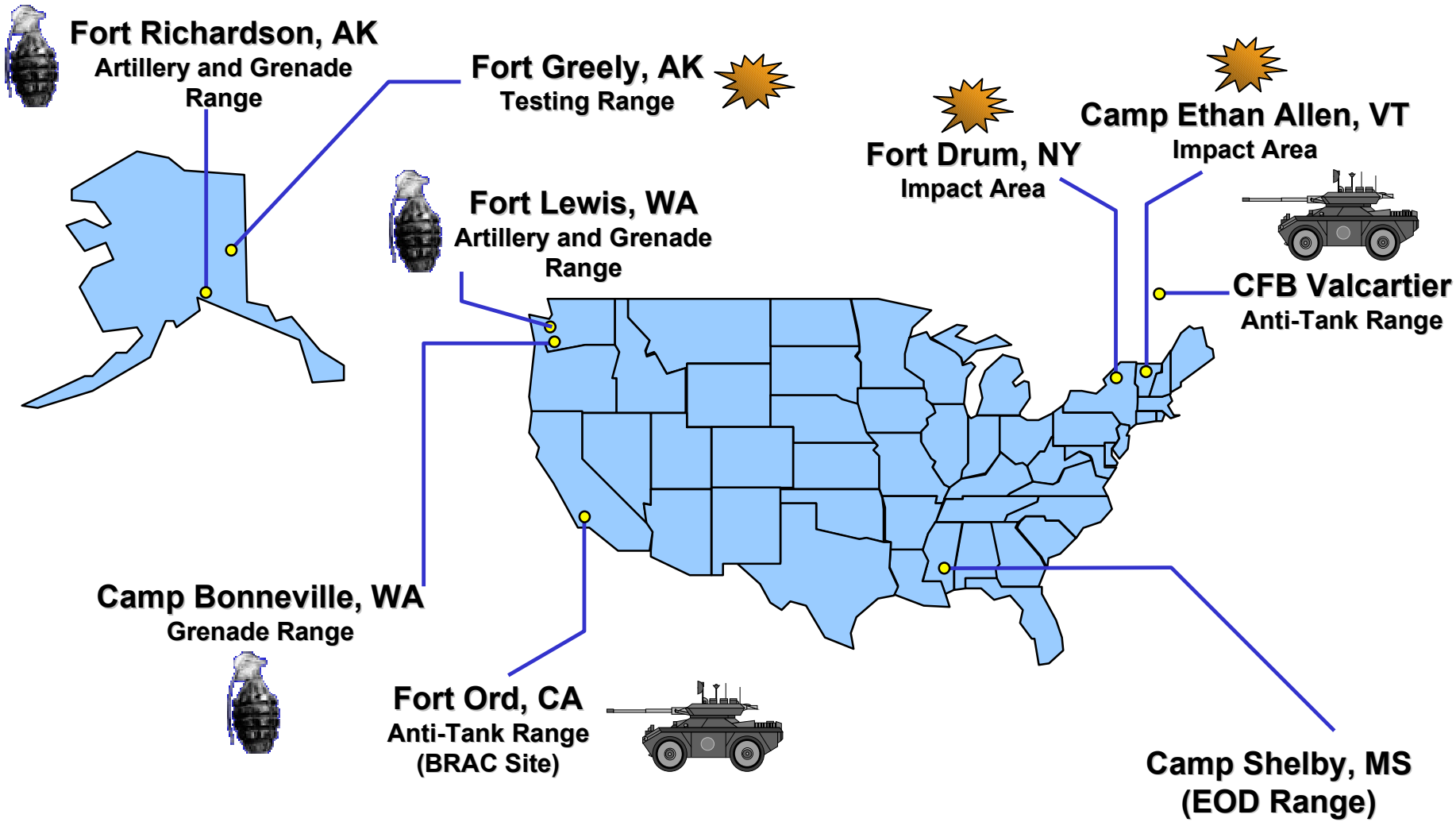
USA Engineer Research and Development Center
Cold Regions Research and Engineering Laboratory
72 Lyme Road, Hanover NH 03755

SERDP Partners
CP1155

Distribution and Fate of Energetics on DoD Testing and Training Ranges

- Dr. Judith Pennington, ERDC-EL
- Dr. Thomas Jenkins, ERDC-CRREL
- Dr. James Brannon, ERDC-EL
- Dr. Sonia Thiboutot, DREV (Canada)
- Jay Clausen, AMEC
- John Delaney, NAVEOD

Testing and Training Ranges Studied



Rationale for Residue Studies

- Groundwater contamination with RDX
- Explosives residues in surface soils serve as source for groundwater contamination
- Task - Estimate deposition of explosives residues from detonation of various munition items

Sources of Residues of Explosives and Propellants on Training Ranges

- Incomplete propellant combustion during firing activities
- Ordnance blast residues from high-order detonations
- Low-order detonations of various ordnance items
- UXO blow-in-place operations (BIPs)
- Open burning of excess propellant
- Corrosion of surface and subsurface UXO
- Rupture of UXO items by detonations

Difficulties in Estimating Residues from Detonations of Army Munitions

- Testing and training ranges are often contaminated from past operations
- Actual area of deposition on soil is difficult to identify
- Deposition is spatially heterogeneous
- Good estimate of residue deposition requires sampling of large surface areas
- Exact impact area for fired rounds unpredictable

Potential Advantages of Conducting Residue Studies on Snow-Covered Range

- **Fresh snow surface is free of contamination from past detonations**
- **Easy to differentiate between fresh impacts vs. older ones for fired rounds**
- **Area of deposition is easy to identify visually**
- **Large surface area samples are easy to collect**

Munitions Studied Thus Far

- 81-mm mortars detonated with C4 (4)
- Fired 60-mm mortars, fired with point detonation (2), proximity detonation (5)
- M67 hand grenades thrown with timed detonation (7)
- 120-mm mortars (5), fired with point detonation
- C4 alone (8)
- M15 antitank mine (1), detonated with C4
- M19 antitank mine (1), detonated with C4
- Claymore mine (8)
- PMA-2 antipersonnel mine (1), detonated with C4

Hand Grenade Information M67

- **High explosive - Composition B**
- **Composition B - 60% RDX, 39% TNT**
- **Mass of explosives in M67 grenade**

RDX – 111 g **TNT – 72 g**

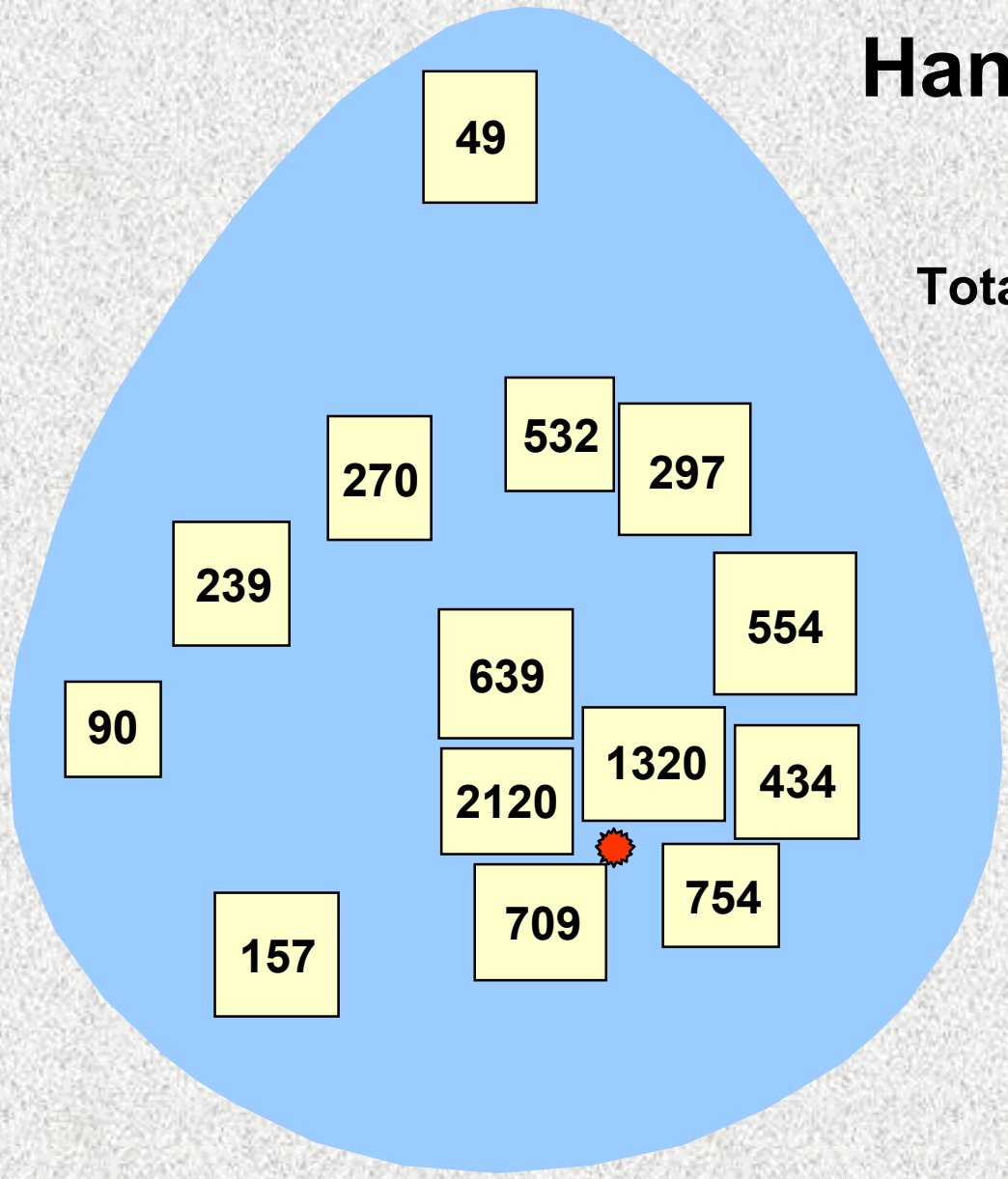
Snow Surface after Hand Grenade Detonations

Sample Collection after Hand Grenade Detonations

Hand Grenade No. 7
Ft. Drum, NY

Total RDX Deposited: 62 µg

RDX (ng/m²)



Hand Grenade Residues

Trial#	Area (m^2)	Mass (µg) RDX
1	24	24.1
2	28	20.1
3	25	15.1
4	20	12.8
5	24	16.3
6	30	33.3
7	100	61.8
Mean	36	26.2

Conclusions from Hand Grenade Study

- **Average mass of explosives determined in residues from seven M67 detonations**

  RDX – 26 µg TNT – < 1 µg

- **Mass of explosive in M67**

  RDX – 111 g TNT – 72 g

- **Average % of explosive remaining after high order detonation**

  RDX – 0.000023% TNT – <0.000001%

Ft. Lewis
Hand Grenade Range

Ft. Lewis
Hand Grenade Range

- About 1500 grenades thrown per year in studied area at Ft. Lewis

  1500 x 26 µg = 39 mg-RDX
  1500 x <1 µg = < 2 mg-TNT

- Average concentrations found in soil

  RDX 4.4 mg/kg-soil
  TNT 2.2 mg/kg-soil

- Mass of soil (15m x 15m x 1cm) = 3825 kg
- Mass of residues present: RDX = 17 g
  TNT = 8.4 g
- High order detonations cannot account for the concentrations found

Dud and Low-Order Rates for M67 Hand Grenades

- **Dud rate**

  0.83%

- **Low-Order rate**

  0.93%

M67 Hand Grenade

Low Order Detonations

Estimation of Residue Deposition by Ordnance

Munition Type	Residue (µg) Deposition		
	RDX	TNT	HMX
M67 Hand Grenade	26	<1	<1
81-mm Mortar (C4)	35,000	240	6,000
C4 alone	61,000	<1	26,000
M19 Anti-Tank Mine (C4)	280	<1	860
M15 Anti-Tank Mine (C4)	4,000	8	410
60-mm Mortar (Point Det)	630	18	8
60-mm Mortar (Proximity)	72	14	19
120-mm Mortar (Point Det)	4,000	320	140

C4 Detonations

C4 Detonations

C4 Detonations

C4 Detonations

Munitions to be Studied (FY 2002)

- 155-mm howitzer rounds, detonated with C4 above ground
- 105-mm howitzer rounds, fired
- 81-mm mortar rounds, fired
- Claymore mines
- PMA-2 mines
- PMA-1A mines
- Other antipersonnel mines

Claymore Mine Detonations

Low Order Detonations

Overall Conclusions and Recommendations

- **High-order detonations deposit very low levels of explosives residues**

  Deposition: RDX>HMX>TNT>>2,4-DNT

- **Fired rounds appear to produce less residue than those detonated with C4**
- **Much greater deposition of explosives residues from low-order detonations**
- **Recommendation that firing into hand grenades to detonate duds be eliminated (low orders)**
- **Recommendation that an alternative to C4 for BIPs be evaluated**

CRREL Participants

- Alan Hewitt, ERDC-CRREL
- Marianne E. Walsh, ERDC-CRREL
- Thomas Ranney, Science and Technology Corporation
- Jeffrey Stark, ERDC-CRREL
- Dr. Susan Taylor, ERDC-CRREL
- Michael R. Walsh, ERDC-CRREL
- Dennis Lambert, ERDC-CRREL