

Munitions Constituents That Are Emerging Contaminants

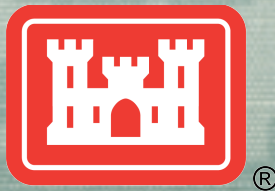
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Emerging Contaminants (ECs)

- As identified by DoD, a contaminant that:
 - ▶ Has a reasonably possible pathway to enter the environment;
 - ▶ Presents a potential unacceptable risk; and
 - ▶ There is no currently published health standard or there is an existing health standard, but *the standard is evolving due to new science, detection capabilities, or pathways.*



Other Organizations: ECs

- EPA Federal Facilities Restoration and Reuse Office
 - ▶ “An emerging contaminant (EC) is a chemical or material characterized by a perceived, potential, or real threat to human health or the environment or by a lack of published health standards. A contaminant also may be "emerging" because of the discovery of a new source or a new pathway to humans.”

http://www.epa.gov/fedfac/documents/emerging_contaminants.htm#additional_ec



Other Organizations: ECs

- EPA Office of Water Contaminants of Emerging Concern – Primarily personal care products and pharmaceuticals
- “...previously had not been detected or are being detected at levels that may be significantly different than expected....generally referred to as “contaminants of emerging concern” (CECs) because the risk to human health and the environment associated with their presence, frequency of occurrence, or source may not be known.”



<http://water.epa.gov/scitech/cec/index.cfm>



Other Organizations: ECs

- National Oceanic and Atmospheric Administration
- Emerging Marine Contaminants
- Research to develop methods and quantify risks to estuarine environments

<http://www.hml.noaa.gov/ohh/envchem/emergecont.aspx>



Department of Defense: ECs

- As identified by DUSD (I&E), a contaminant that:
 - ▶ Has a reasonably possible pathway to enter the environment;
 - ▶ Presents a potential unacceptable risk; and
 - ▶ There is no currently published health standard or there is an existing health standard, but *the standard is evolving due to new science, detection capabilities, or pathways.*



Source: DoD Instruction 4715.18 6



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DoD Instruction 4715.18

- Title: *Emerging Contaminants*; recently recertified
- Establishes DoD program and responsibilities
- Process for selecting toxicity values for ECs
- Initiation of actions related to environmental releases of ECs



DoD Strategies & Processes

- Identify ECs early that can affect DoD
- Assess risks
- Develop consensus risk management options
- Track implementation



DoD's Scan, Watch, Action Process: Identifying, Prioritizing & Pursuing Risk Management

Over -the- horizon



EC News

Review literature, periodicals, regulatory communications, etc.

Possible DoD impacts

Phase I
Assessment

Monitor events; Conduct Phase I qualitative impact assessment; Manage obvious risks.

Probable high DoD impacts

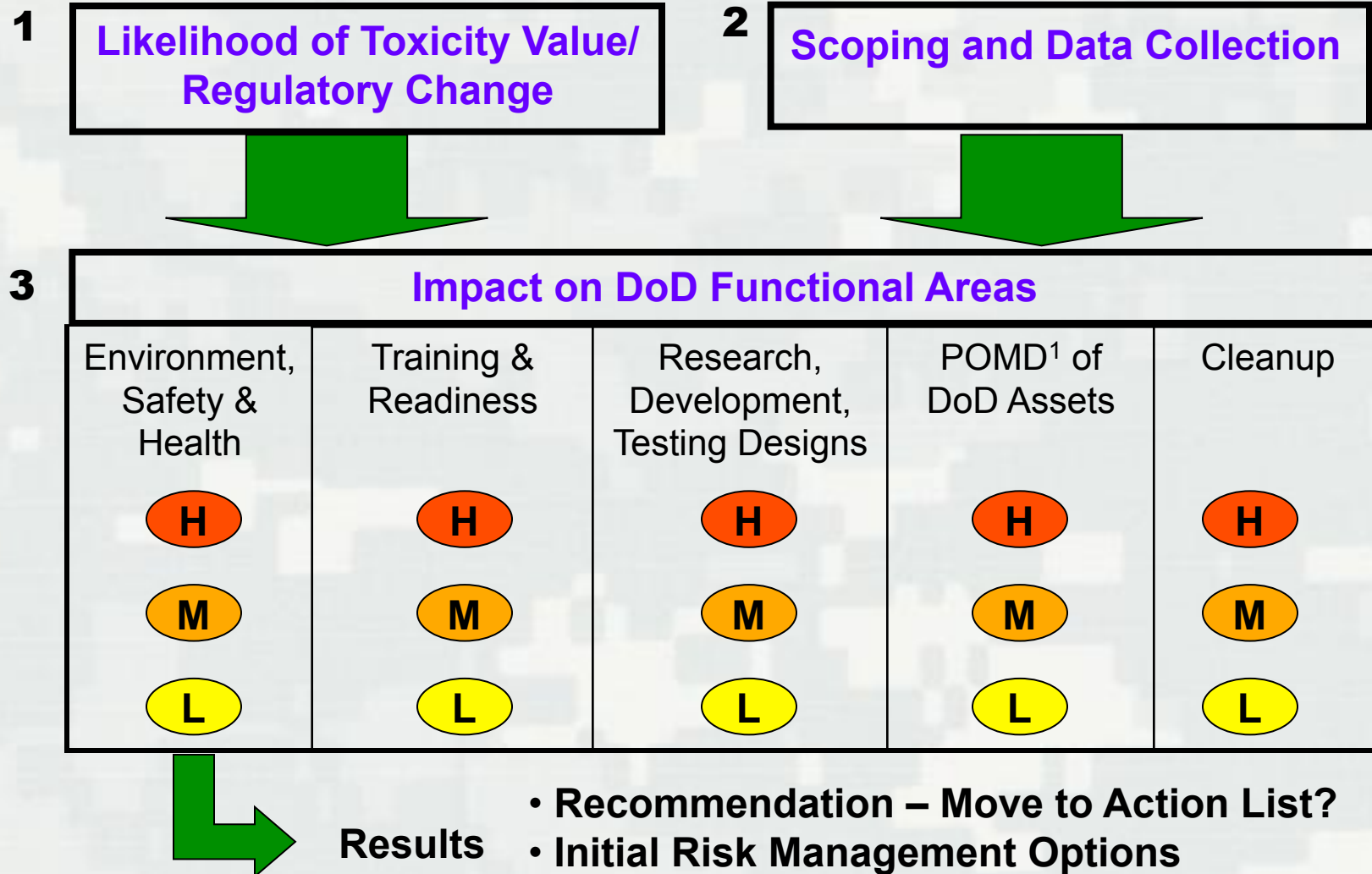
Phase II
Assessment

Conduct Phase II quantitative impact assessment; Develop & rank risk management options (RMOs); Implement approved RMOs; Track implementation and reduce high risks; Revisit list annually for risk reduction progress and triggers for listing

Risk Management Options
to ECGC

Approved RMOs become Risk
Management Actions (RMAs)

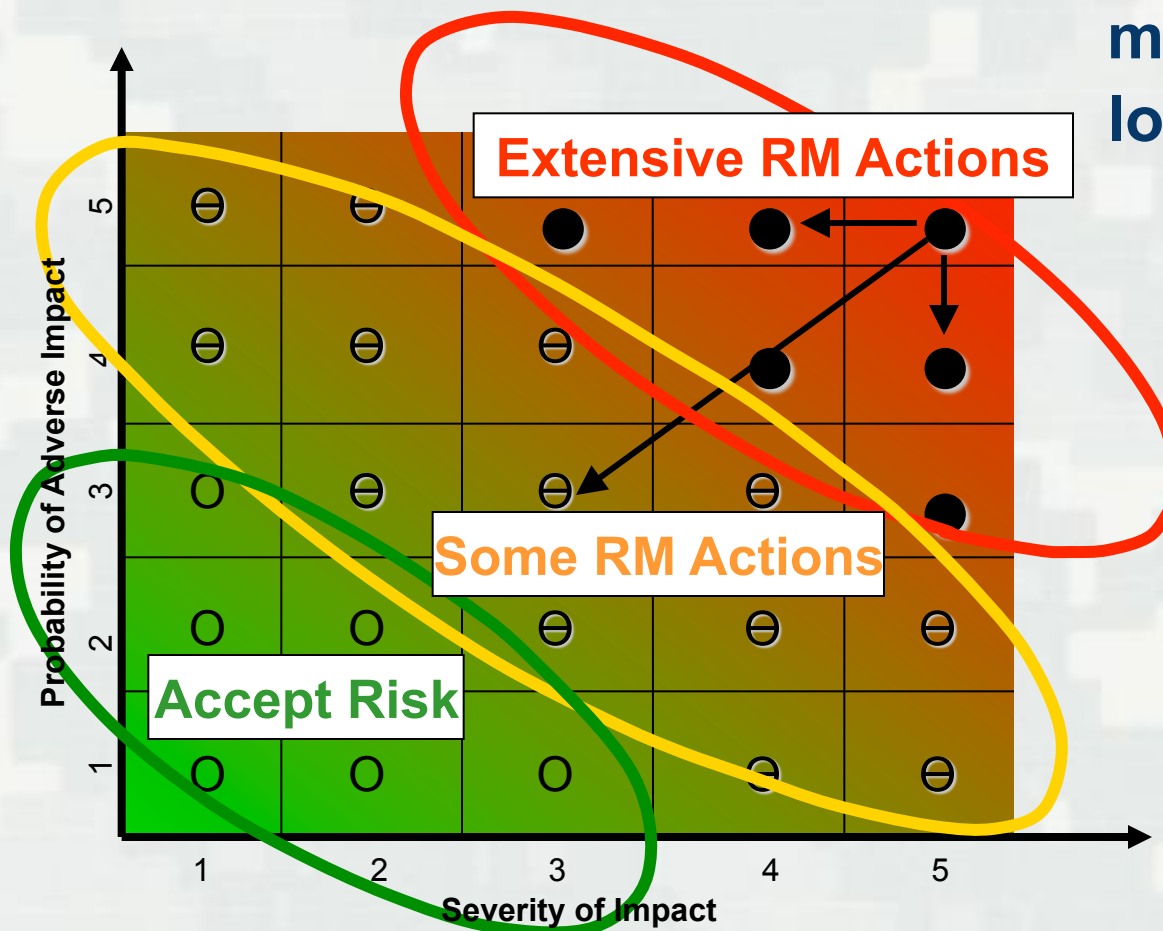
Phase I Impact Assessment Process



EC - Integrated Risk Management

- Define the negative influences on the enterprise in question.

Identify strategic risk management options to lower severe risks.



- Exposure assessment & monitoring
- RDT&E
 - Material substitution
 - Process changes
 - Fill tox science gaps
- Acquisition changes
- Legislative engagement
- Stockpile material
- Personal Protective Equipment
- Risk communication
- Training

Measure progress on risk reduction measures taken.

Emerging Contaminant Watch List

- 1,4-dioxane
- **Antimony**
- *Cadmium and Compounds*
- *Cobalt and Compounds*
- Decabromodiphenyl ether
- Diisocyanates
- **2,4-Dinitroanisole (DNAN)**
- **Dinitrotoluene (DNT)**
- Dioxins
- *Manganese and Compounds*



Emerging Contaminants Watch List (cont.)

- Nanomaterials – carbon
- Nanomaterials-metals
- *Nickel*
- N-nitrosodimethylamine (NDMA)
- **5-Nitro-1,2,4-triazol-3-one (NTO)**
- **Perchlorate**
- Perfluorooctane Sulfonic Acid (PFOS)
- Perfluorooctanoic Acid (PFOA)
- N-Propyl Bromide
- Trichloroethylene (TCE)
- *Tungsten and Alloys*
- *Vanadium*



Emerging Contaminants Action List

- **Lead compounds**
- Chromium VI
- Beryllium
- Naphthalene
- **Cyclotrimethylenetrinitramine (RDX)**
- Sulfur Hexafluoride (SF6)
- Phthalate Esters



DNAN and NTO; Basis for Inclusion on EC Watch List

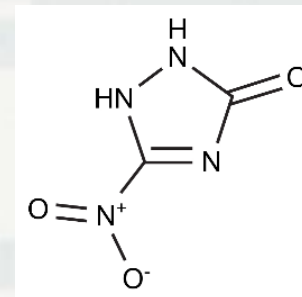
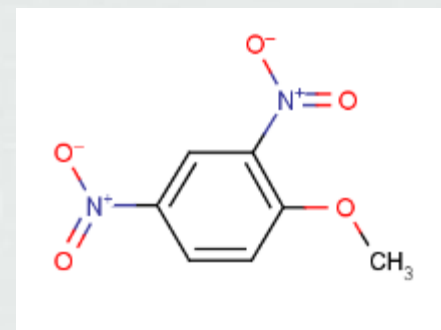
- Insensitive munitions replacements for RDX and TNT, for example IMX 101, IMX 104, OSX-12, PAX 21, and PAX 48
- Currently not highly regulated
 - ▶ TSCA limits discharge
- Army Institute of Public Health has developed recommended occupational exposure levels



Studies Ongoing by DOD to Understand Toxicity, Fate & Transport

Initial findings:

- DNAN likely less toxic than TNT
- NTO -
 - ▶ Male reproductive impacts
 - ▶ Low bioaccumulation potential
 - ▶ Has capacity to migrate



Phase I Impact Assessments

- DNAN will be performed fourth quarter FY14
- NTO Results:
 - ▶ DoD is using NTO and insensitive munitions containing the compound responsibly.
 - Health and safety protocols are in place at production and Load-Assemble-Pack (LAP) facilities
 - Waste streams carefully controlled.

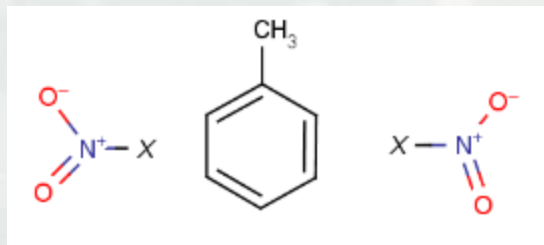


Phase I Impact Assessment

- Identified risks associated with NTO:
 - ▶ Improve wastewater treatment systems to accommodate greater nitrogen load from increased production
 - ▶ Occupational – current environment exposure well below the proposed OEL of mg/m^3 , but as operations move to full-rate production, there may be increased exposure

NTO remains on the Watch List.





Dinitrotoluene

- New screening provisional peer reviewed toxicity value issued by EPA for technical grade DNT and for 2,6-DNT
- The mixture is assumed to be 76% 2,4-DNT and 19% 2,6-DNT, the remaining 5% of the mixture is assumed to be a mixture of 2,3-, 2,5-, 3,4- and 3,5-DNT

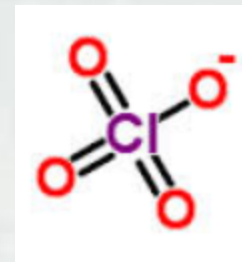


Dinitrotoluene

- EPA Regional Screening Levels for technical grade DNT are 3x higher than 2,6-DNT
- Values not published for 2,3-, 2,5-, 3,4- and 3,5-DNT separately; screening level applied to total DNTs
- DNTs are regulated as totals by State of Wisconsin: 0.05 µg/L



Perchlorate



- Moved from EC Action List to Watch List several years ago
- Reference dose published in EPA's Integrated Risk Information System (IRIS) 2005
- Several States have MCLs; Federal MCL under development
 - ▶ CA MCL is 6 ppb; in 2012 released a public health goal of 1 ppb



Perchlorate MCL Timeline

- 2005 - National Research Council: *Health Implications of Perchlorate Ingestion*, establishes reference dose (RfD) for perchlorate
- Oct. 2008 – EPA published preliminary determination not to regulate perchlorate
- Jan. 2009 – EPA published interim health advisory level of 15 µg/L
- Aug. 2009 – EPA published health reference levels for various life stages of 1 to 47 µg/L for comment
- Feb. 2011 – EPA published final determination to regulate perchlorate



Perchlorate MCL Timeline

- May 2012 – EPA Science Advisory Board (SAB) publishes advice on development of the MCL
- Sept. 25, 2012 – EPA shares information regarding analytical methods and treatment technologies in public meeting
- ~~Feb. 2013; Dec. 2013~~ Statutory deadline to publish MCLG and MCL proposal
- ~~Aug. 2013; Aug. 2014~~ Statutory deadline to publish final MCL



Major Conclusions in Draft SAB Advisory Report

- Sensitive Life Stage
 - ▶ Change from NRC 2005: From pregnant women with hypothyroidism to hypothyroxinemic pregnant women (and their fetus/infant)
- Epidemiology and Biomonitoring Data
 - ▶ Insufficient but meta- or pooled analysis might provide important information
- PBPK Modelling
 - ▶ Integrate mode of action





Lead

- Center for Disease Control (CDC) now uses a reference level of 5 $\mu\text{g}/\text{dL}$ blood lead level (BLL). Is based upon upper 2.5% tile of 1-5 year olds tested in the U.S.
- Previously 10 $\mu\text{g}/\text{dL}$ BLL was a “level of concern”
- EPA may adopt the new value; associated soil level may be 150 mg/kg





Lead

- Evolving science & regulations may pose a risk to personnel & range operations
- Lead-free electronics pose a risk to DoD supply chain...short-circuiting in components



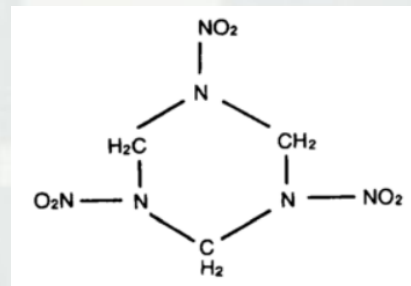
Lead Risk Management Actions

- RDT&E on lead free munitions
- DoD-Industry Consortium on lead-free electronics
 - ▶ Develop technologies to detect lead-free circuit boards
 - ▶ Develop viable lead-free solders
- National Academy of Sciences Study
 - ▶ Concern: Lead exposures to personnel such as small-arms range instructors given new human health science
 - ▶ Conclusion: “A review of the epidemiologic and toxicologic data allowed the committee to conclude that there is overwhelming evidence that the OSHA standard provides inadequate protection for DOD firing-range personnel and for any other worker populations covered by the general industry standard.”
- Underway: Development of DoD BLL standards
 - ▶ Surveillance & action levels



RDX

- DoD invested in RDX toxicity research that has been published and will be used in the ongoing IRIS reassessment of its toxicity.
- Drinking water level of concern 0.61 $\mu\text{g/L}$ based upon cancer effects. Newer data suggest that a cancer value may not be warranted.



RDX

- Data supporting a change in the cancer toxicity value
 - ▶ Large body of evidence suggest it is not genotoxic or mutagenic
 - ▶ Two year rat study was negative
 - ▶ No human data link RDX to cancer
- Neurotoxicity or prostate inflammation will likely drive the noncancer reference dose

