Managing Chemical & Material Risks

Acquisition, Technology and Logistics

DoD Emerging Contaminants Program Update

Briefing for Federal Remediation Technologies Roundtable

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Emerging Contaminants Program Genesis

- **~2004 – Perchlorate[1] detections in groundwater & drinking water cause national concern**
  - Disputes between DoD and regulators over response actions
  - Training/testing on 2 ranges curtailed
- **2005/6 – DoD forms EC Work group with EPA & Environmental Council of States**
  - EC Definition & three policy papers developed & approved
    1) What triggers actions for EC releases?
    2) How to determine toxicity values for risk assessments
    3) EC Risk Communication
- **2009 – DoD issues EC policy instruction**
  - Key elements based on DoD-EPA-ECOS policy papers

[1] An oxidizer chemical found in munitions, pyrotechnics, and rocket fuels

What is an Emerging Contaminant?

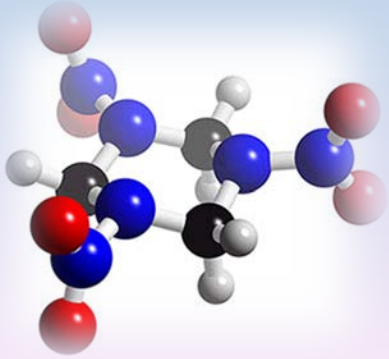
- Chemicals & materials that have pathways to enter the environment and present real or potential unacceptable human health or environmental risks…

and either

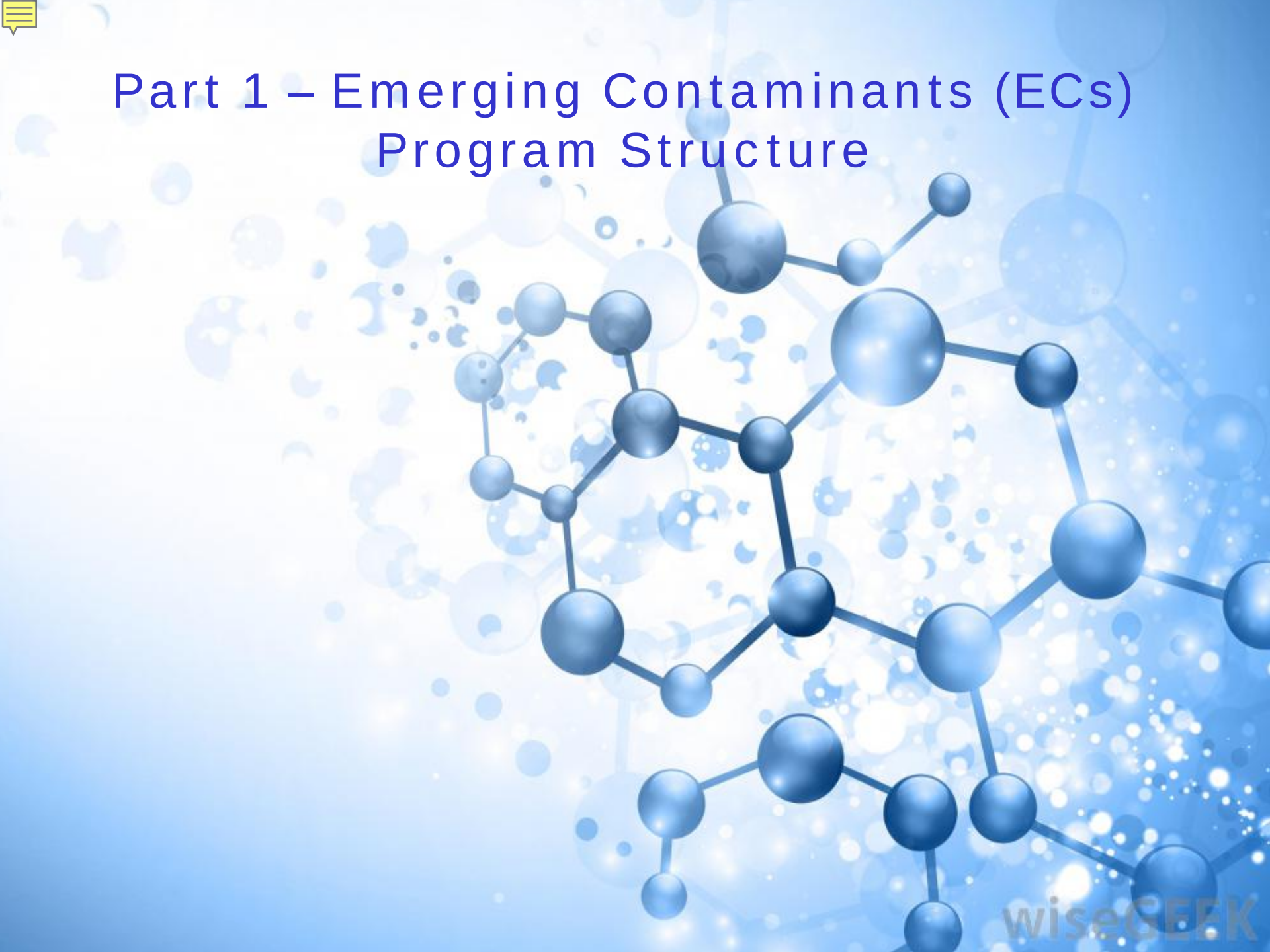
  - do not have peer-reviewed human health standards

or

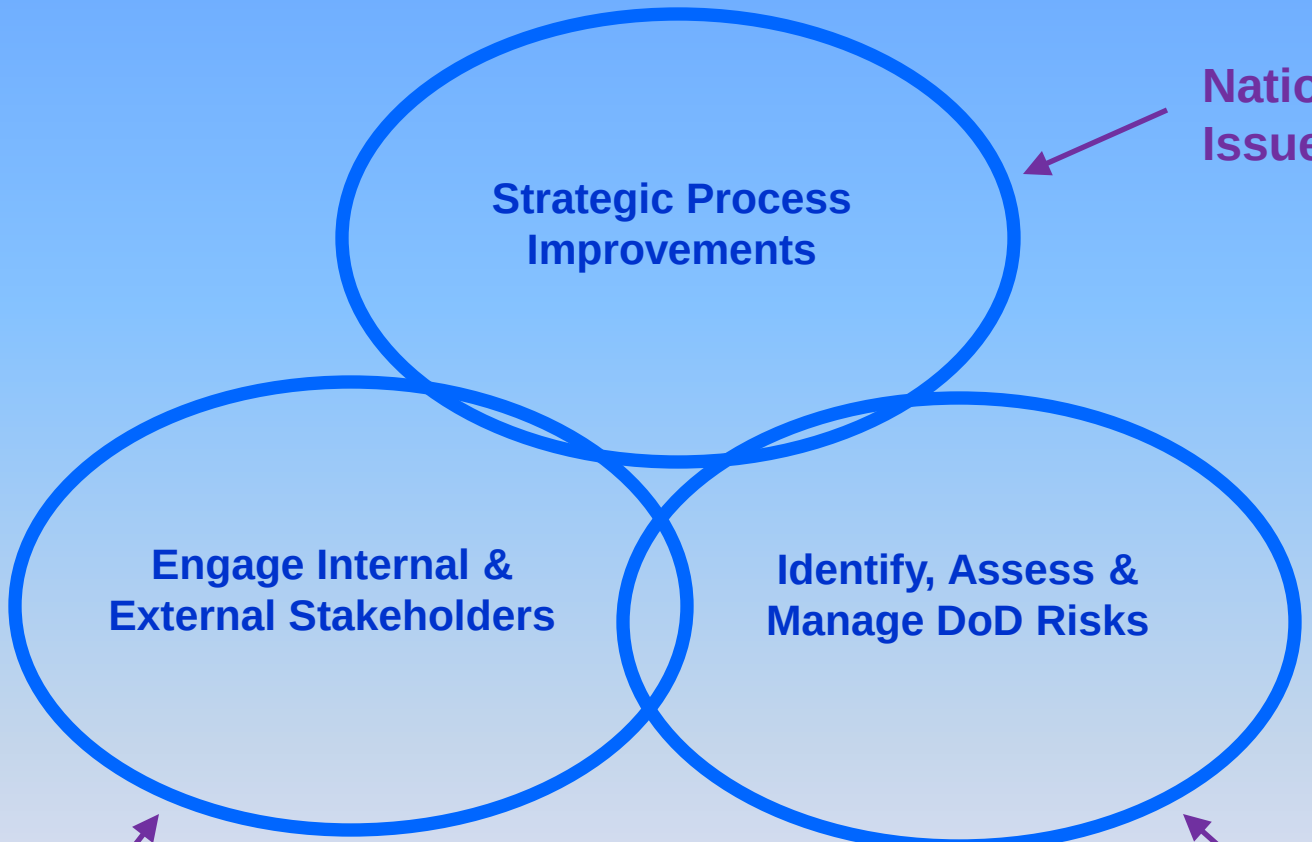
  - Standards/regulations are evolving due to new science, detection capabilities, or pathways.



Part 1 – Emerging Contaminants (ECs) Program Structure



Program Strategic Priorities



National Level Issues

DoD, Federal, State, NGOs, & Industry

Internal DoD & Industry Partners

EC "Scan-Watch-Action" Process

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

Probable high DoD impacts

Phase II Assessment

Conduct Phase II quantitative impact assessment; develop & rank Risk Management Options (RMOs)

RMOs to EC Governance Council

Approved RMOs become Risk Management Actions (RMAs)

Functional Areas Assessed

Acquisitions / Research, Development, Testing, and Evaluation

Environment, Safety & Health

Production, Operation, Maintenance, and Disposal of Assets

Cleanup/Remediation

Training & Readiness

7

SF6 Phase I Impact Assessment

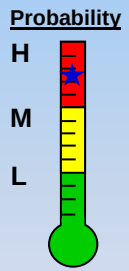
Completed January 2008

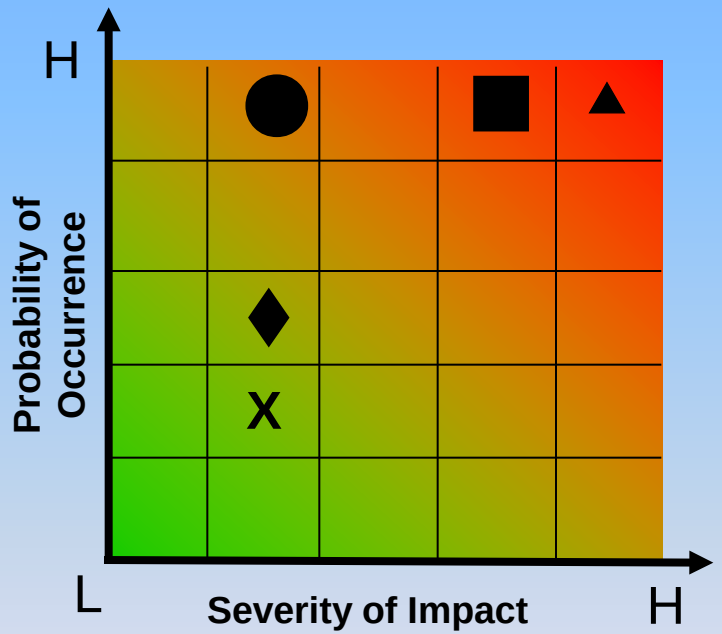
Acquisition, Technology and Logistics

Sulfur Hexafluoride (SF6) is used in radar systems (e.g., AWACS aircraft); helicopter rotor-blade leak tests; discharge testing in fire suppression systems; electrical switch gear; and propulsion systems for specific weapons (e.g., MK-50 torpedo) in service and under design.

Likelihood of Toxicity Value/ Regulatory Change

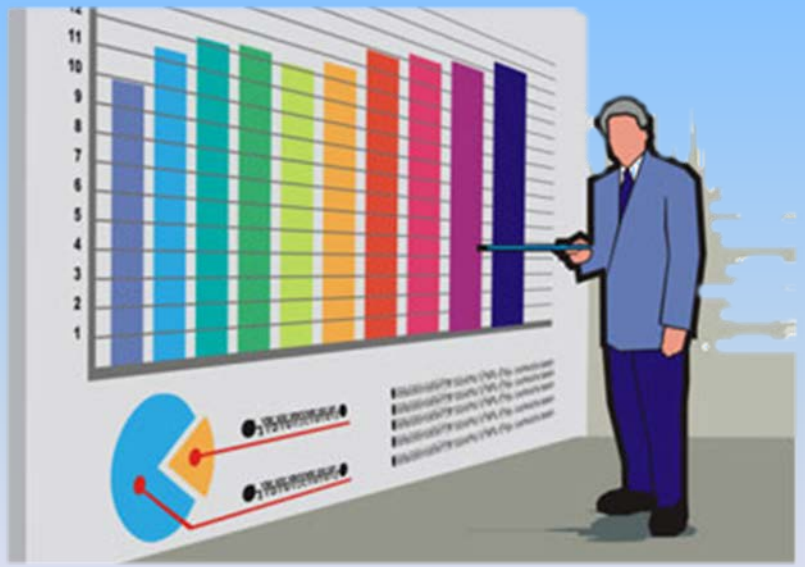
1. **Probability that Greenhouse Gas emission initiatives will restrict use/availability of SF6**





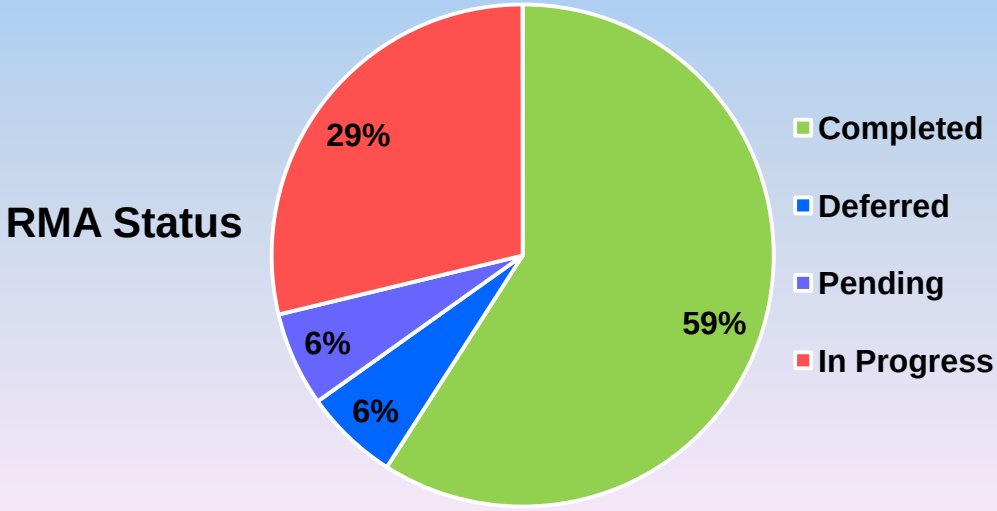
- ES&H
- Training & Readiness
- Acquisition/RDT&E
- PO&MD of Assets
- X Cleanup

Part 2 – Progress Report



EC Program Scorecard – Cumulative

- **Potential ECs screened --- over 580**
- **Phase I Impact Assessments completed --- 39**
- **Phase II Impact Assessments completed --- 11**
  - All current/former action list chemicals completed.
- **Risk Management Actions (RMAs) --- 66**



Note: See EC Action and Watch Lists in Tab B

EC Watch List – January 2016

- ✓ Tungsten/alloys
- ✓ 1,4-dioxane
- ✓ Metal Nanomaterials
- ✓ Carbon Nanomaterials
- ✓ PFOS
- ✓ PFOA
- ✓ Nickel
- ✓ Cadmium
- ✓ Manganese
- ✓ Dioxin
- ✓ HFCs (10)
- ✓ Vanadium & compounds

- Cobalt
- Antimony
- ✓ Flame retardants (6)
- ✓ Diisocyanates
- ✓ NDMA
- ✓ DNT
- ✓ DNAN
- ✓ NTO

Energetic Compounds

- ✓ TCE …moved from action list
- ✓ Perchlorate …moved from action list
- Strontium…added March 2015
- Chlorinated paraffins…added June 2015

✓ **Phase I Impact Assessment completed**

Notes:

- Di-nitrotoluenes (DNT)
- Perfluorooctanoic acid (PFOA)
- Perfluorooctyl sulfonate (PFOS)
- decabromodiphenyl ether (decaBDE)
- 5-Nitro-1,2,4-triazol-3-one (NTO)
- N-Nitrosodimethylamine (NDMA)
- Trichloroethylene (TCE)
- 2,4 dinitroanisole (DNAN)
- Hydrofluorocarbons (HFCs)

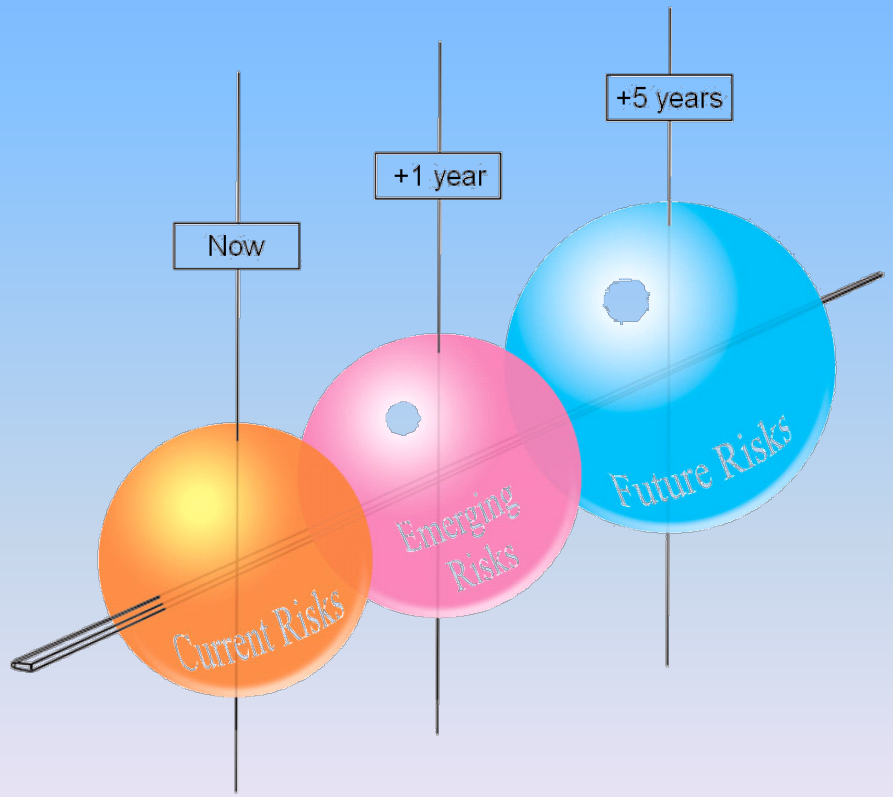
EC Action List – January 2016

- ✓ Royal Demolition eXplosive (RDX)
- ✓ Hexavalent Chromium (Cr6+)
- ✓ Naphthalene
- ✓ Beryllium
- ✓ Sulfur Hexafluoride (SF6)
- ✓ Lead
- ✓ Phthalates
- ✓ 1-Bromopropane
- ✓ TBBPA…added by ECGC in DEC 2015

✓ **Phase II Impact Assessment completed.**

RDX = Cyclotrimethylenetrinitramine TBBPA = Tetrabromobisphenol_A

Part 3 – Risk Management Actions

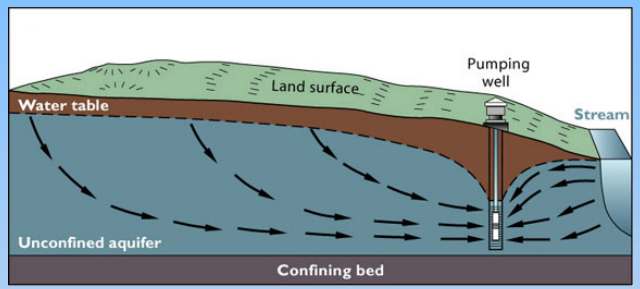


Example Risk Management Actions Completed

- **Perchlorate research; DoD Policy; Over 50,000 samples taken; Congressional Myth-busters brief**
- **Hexavalent chromium research; DoD policy memo; Defense Federal Acquisition Regulation**
- **SF_6[1] policy on capture & recycling**
- **Beryllium life cycle study**
- **Development of innovative naphthalene dosimeter for fuel handlers**
- **RDX[2] toxicological studies**
- **Coordination with Program Manager for chem/bio protection equipment related to phase-out of phthalates**

[1] Sulfur Hexafluoride [2] Cyclotrimethylenetrinitramine

Part 4 – Response to EC Releases

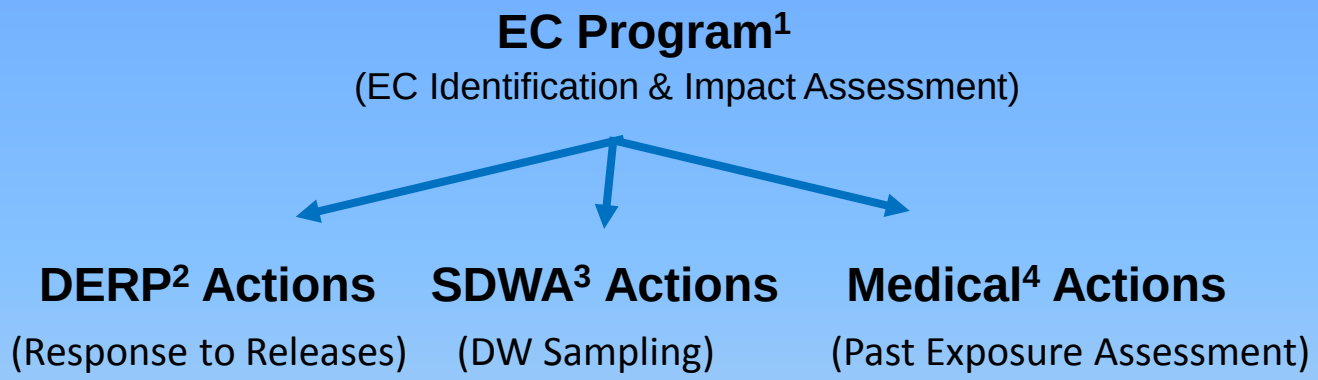


Examples of ECs That Can Impact Groundwater & Drinking Water

- **Perchlorate**
- **RDX[1]**
- **1,4-dioxane**
- **Strontium**
- **PFOA & PFOA**
- **Lead**

[1]Cyclotrimethylenetrinitramine – an explosive compound

Process for EC Releases



Policies

1. "Emerging Contaminants" DoDI 4715.18
2. "Defense Environmental Restoration Program Manual" DoDM 4715.20
3. Safe Drinking Water" DoDI 4715.05
4. PL 112-239, NDAA 2013, Section 313, requires DoD to issue policy for assessing past environmental exposures. ODASD(ESOH) is developing a DoD Instruction to assess past exposures modeled on requirements for current exposures in DoDI 6055.05, "Occupational and Environmental Health."

Key Triggers & Response Actions for EC Releases

1. **Trigger: Release or suspected release of EC by DoD**

   Action: Confirmation sampling & initial characterization to determine if exposure exists

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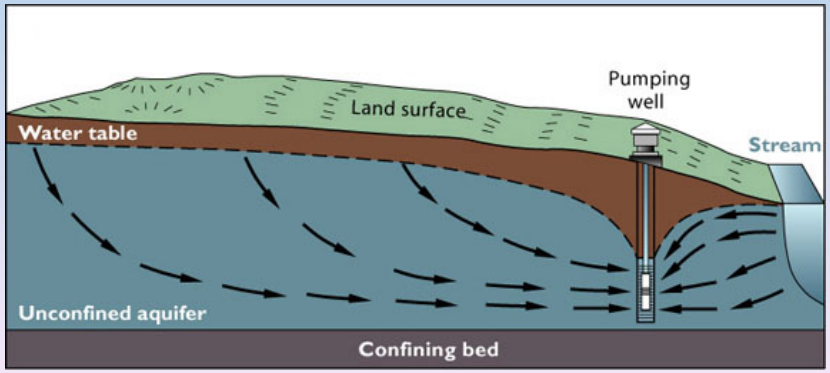

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   Action: Eliminate "unacceptable" exposure via risk management actions

3. **Trigger:** Peer reviewed toxicity standard (e.g., RfD) is published; ***Don't need MCL***

   Action: Site is integrated into DERP[1] for site-specific risk assessment and possible remedial action

[1] Defense Environmental Restoration Program

Three Scenarios Where Exposure Exists

- **Scenario 1** – An RfD and a PHA, MCL, and/or cleanup standard exists

- **Scenario 2** – A peer-reviewed RfD exists; the RfD may or may not be listed in IRIS; the RfD may be used by EPA to publish a PPRTV or an RfD may be listed in a state database.

- **Scenario 3** – No peer-reviewed RfD exists, thus no value in IRIS. These will be rare cases, if any, and handled on a case-by-case basis.

PFOA/PFOS History

1949 – 3M begins producing PFOS compounds; used in "Scotchgard"

1999 – EPA begins investigating PFCs based on toxicity studies and prevalence in environment

Through 2001- PFOS used in making AFFF (fire fighting foam)

2006 – EPA & 8 companies announce PFC Stewardship program for production phase-outs by end of 2015

June 2007 – DoD EC Program completes a Phase I Impact Assessment for PFOA & PFOS

* Assessment notes risk related to PFOS releases at AFFF sites

~2007-present – Services begin to identify sites; response actions delayed due to uncertainty in toxicological science

January 2009 – EPA issues Preliminary Health Advisories for PFOA & PFOS & indicates plans for full assessment of science

May 2012 – EPA issues UCMR #3 with PFOA & PFOS

February 2014 – EPA Office of Water issues draft risk assessment; when finalized will become new Lifetime Health Advisory

Department of Defense Emerging Contaminants Program

Harvard University “Innovations in American Government” Award

Backup Slides

The Defense Context

Equipment, weapon systems, and platforms provided to the war-fighter are made from, and depend on, chemicals & materials.












Vital chemicals & materials needed for production, performance, and sustainment of systems are increasingly at risk from becoming non-available

Global Chemical Management Trends

- **Use of Precautionary Principle**
  - Must understand health & environmental effects before using chemicals
- **Biomonitoring – What's showing up in humans?**
  - Centers for Disease Control's national bio-monitoring & California voluntary program
- **Strict Chemical Management & Green Chemistry**
  - Cradle to grave
- **Evolving Risk Assessment Science & Process**
  - EPA IRIS[1] program
- **International, Federal, & State Toxic Substances Laws**
  - EPA Chemical Action Plans
  - California Green Chemistry Law
  - European Union's REACH[2] regulation
  - Pending Toxic Substance Control Act reform

[1] Integrated Risk Information

[2] Registration, Evaluation, Authorization & Restriction of Chemicals

Regulatory Trends

Develop prioritized list of toxic chemicals

(e.g., REACH Chemicals of Very High Concern & EPA Chemical Action Plans)

Assess uses & exposures

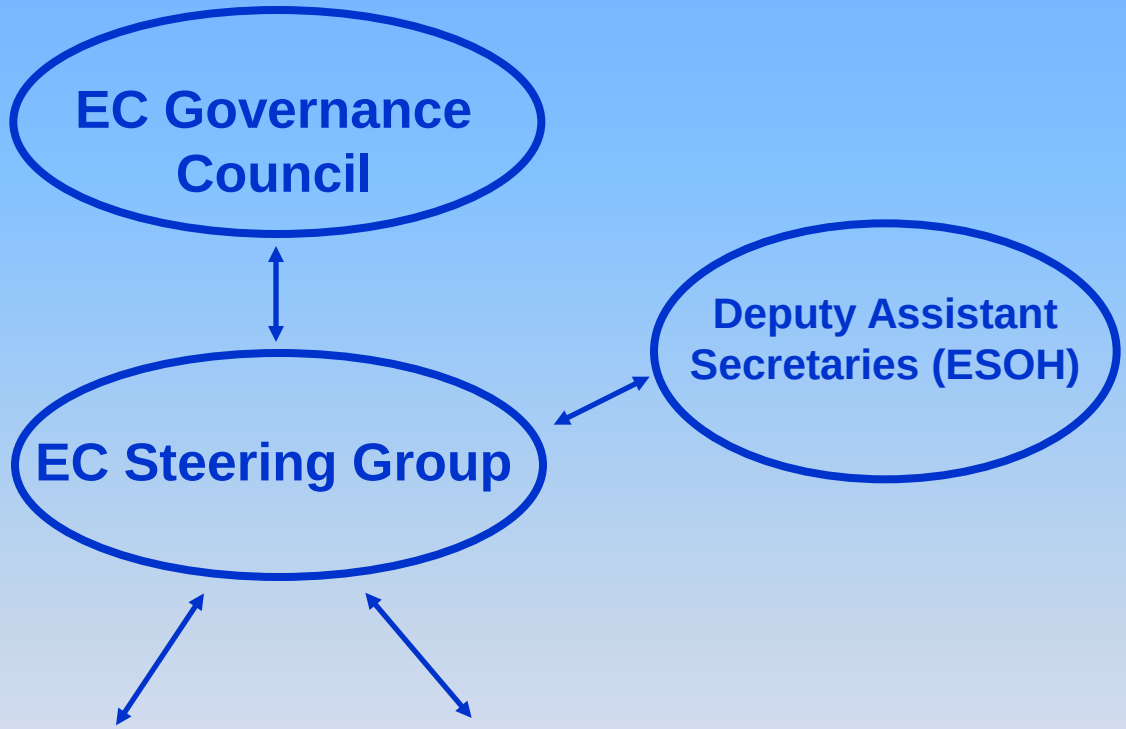
Issue risk management actions/regulations

(e.g., Restrictions or production bans)

How Can ECs Affect DoD?

- **Present risks to operating forces, DoD employees, and/or public**
  - Human health protection paramount
- **Reduce training/readiness**
  - Restrictions on use of ranges
- **Restrict availability and/or cost of materials or chemicals**
  - Adverse impact on mission-critical applications & industrial base community
- **Increase O&M and/or cleanup costs**
  - Diverts resources from core mission

EC Program Governance



MERIT= Materials of Evolving Regulatory Interest Team – a virtual DoD-wide team

Perchlorate Management Strategy

- **DoD Policies & Sampling/Characterization – Find the releases**
  - DoD Sampling began ~15 years ago
  - DoD 2006 sampling policy memo required sampling in all media
  - California site prioritization protocol completed working with the state
  - DoD 2009 policy update uses EPA Preliminary Remediation Goal (PRG)
- **Response via DERP[1] – Address the releases**
  - Lack of MCL *does not stop* response actions
  - Published EPA reference dose (RfD) used for site-specific risk assessments
- **Invest in R&D – Determine sources & substitutes**
  - Over $114M invested
  - Perchlorate substitutes
  - Sources, sampling & analytical methods
  - Treatment technologies

[1] Defense Environmental Restoration Program

Lead – Why on the Action List?

- **Evolving science & regulations may pose a risk to personnel & range operations…most munitions contain lead**

Range Instructor

- **Lead-free electronics pose a risk to DoD supply chain…short-circuiting in components**

Background for Lead
- Risk Management Actions Taken -

- **DoD-Industry Consortium on lead-free electronics**
  - Develop technologies to detect lead-free circuit boards
  - Develop viable lead-free solders
- **RDT&E on lead free munitions**
- **National Academy of Sciences (NAS) Study for DoD**
  - 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."
- **Development of DoD-specific Blood Lead Level standards**
  - **Development of a DoD occupational exposure limit to follow**

Risk Alert: 15-001

From the
Chemical & Material Risk Management Program
Office of the Assistant Secretary of Defense (Energy, Installations & Environment)

Chemical & Material Emerging Risk Alert

Tetrabromobisphenol-A (TBBPA)

The Environmental Protection Agency (EPA) has identified TBBPA (CAS No. 79-94-7) for assessment under the Toxic Substances Control Act (TSCA) Work Plan effort. This may lead to increased regulation and/or production bans, which could pose risk to DoD supply chains and require actions to identify and qualify suitable alternatives.

What is TBBPA?

TBBPA is the most widely used brominated flame retardant,[1] and is considered a substitute for certain polybrominated diphenyl ethers (PBDEs). The main application (~90%)[2] of TBBPA is in the epoxy resin used for printed circuit boards or laminates, where it contributes to the fire safety of consumer electronics, and civilian and defense communication equipment requiring FR-4 protection and V0 requirements of the UL-94 Standard. TBBPA is also used in many polymeric materials and epoxy adhesives. Its role has become increasingly important towards the miniaturization of electronics in which the use of loaded and condensed laminates produce more heat within smaller devices.

How is TBBPA used in the DoD?

Printed circuit board technologies are critical components to nearly every DoD weapon system. Combined DoD electronics, information technology, and electro-optics are estimated to account for roughly 15% of the total DoD budget. Fundamental to military operations, high-density ruggedized and reliable printed circuit boards are incorporated into all navigation, guidance, surveillance, and communication systems, including severe-service items used in extreme conditions (temperatures, high impact/vibrations, or submerged).

TBBPA may be used as an additive flame retardant in acrylonitrile-butadiene-styrene (ABS) plastics, high-impact polystyrene (HIP) foams and phenolic resins. ABS resins containing TBBPA are used in automotive parts, pipes and fittings, refrigerators and various commercial-off-the-shelf (COTS) items employed by DoD.

TBBPA is incorporated into products in two-ways (1) reactively – where its molecularly bonded into the matrix of the treated polymer, and (2) additively – where it is physically combined with the material being treated, rather than chemically bonded. Additive flame retardants are considered more likely to leach from the polymer matrix.

What are the emerging health concerns?

TBBPA reactively incorporated into printed circuit boards is not expected to release into the environment. However, trace amounts of unreacted TBBPA may result in a release to the environment through waste streams. The primary environmental hazard for TBBPA is high-aquatic toxicity, with a moderate potential for bioaccumulation.[3]

Human exposure to TBBPA is possible from inhalation of ambient air and from dermal contact or ingestion of compound dusts from containing products. In both human and animal studies, TBBPA was not a sensitizer.[4] Other animal studies, in vivo and in vitro, exhibited thyroid hormone activity,[5] estrogenic activity,[6] and increased weight of testes and pituitary glands in male offspring.[5]

DEPARTMENT OF DEFENSE MERIT Materials of Evolving Regulatory Interest Team

For more information about chemical and material risks, please visit us at http://www.denix.osd.mil/cmrmd/.