



Chemical and Material Risk Management Program

www.denix.osd.mil/cmrmd

Initiatives to Promote and Adopt Sustainable Chemicals and Materials for DoD

A. Rak¹ and Paul J. Yaroshcak¹

¹Noblis, Inc.

²Office of the Deputy Under Secretary of Defense (Installations and Environment), Science and Technology Directorate

Presented at the Aerospace/Defense Industry

Supply Chain Conference, 2013

Disclaimer: The views expressed in this presentation are those of the authors and do not reflect the official policy or position of the Department of Army, Department of Defense, or the U.S. Government.

Outline

- **Chemical and Material Risk Management Program**
- **Emerging Contaminants**
- **Identification/Assessment/Management**
- **Risk Management Actions**
- **Hex Chrome (example)**
- **Way Forward**

Chemical Related Programs in Our Portfolio

- ❖ **Emerging Contaminants Program**
- ❖ **DoD-wide chemical management policy**
 - ◆ Enterprise chemical data management
 - ◆ REACH¹ Strategic Plan
- ❖ **Review & comment of IRIS risk assessments**
- ❖ **DoD Strategic Sustainability Performance Plan**
 - ◆ Required by E.O. 13514...requires reduction in toxic substances
- ❖ **Sustainable Chemicals & Materials for Defense Forum**
- ❖ **ESOH policy & procedures for DoD acquisition process**
 - ◆ Chemical safety & hazard communication are important elements
 - ◆ Sustainability Analysis Initiative using Life Cycle Assessment

¹ Registration, Evaluation, Authorisation and Restriction of Chemicals

What is an Emerging Contaminant?

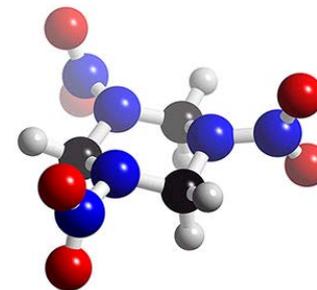
- **Chemicals & materials that have pathways to enter the environment and present real or potential unacceptable human health or environmental risks...**

and either

- ◆ do not have peer-reviewed human health standards

or

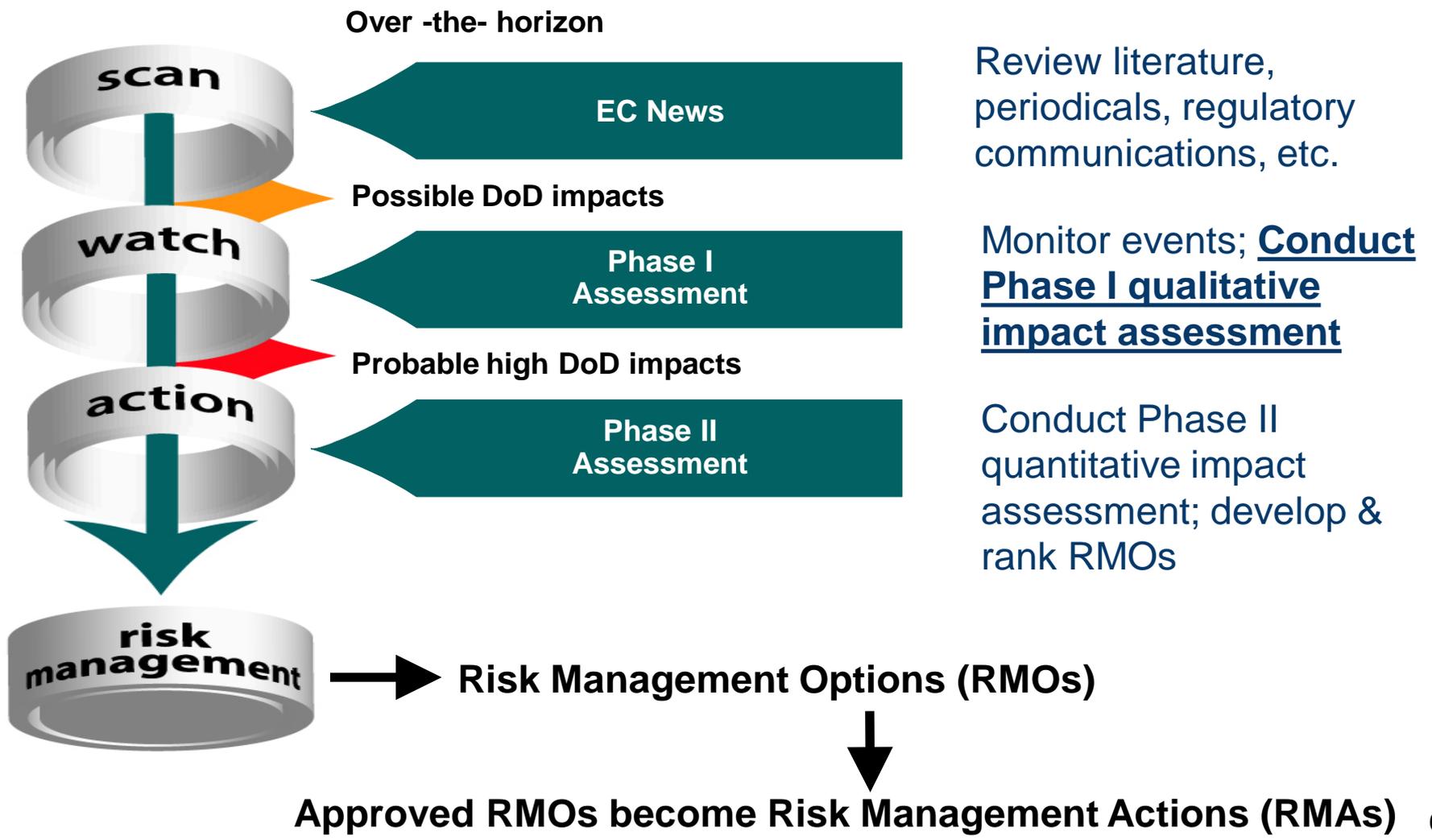
- ◆ Standards/regulations are evolving due to new science, detection capabilities, or pathways.



How Can ECs Affect DoD?

- ❖ **Potential for adverse health effects on 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**
 - ◆ Resource drain from mission needs

Scan-Watch-Action Process



Functional Areas for Impact Assessment



Acquisitions / Research, Development, Testing, and Evaluation



Environmental Safety and Health



Production, Operation, Maintenance, and Disposal of Assets



Cleanup/Remediation



Training and Readiness

Decabromodiphenyl Ether Phase I Impact Assessment

Completed April 2012

Decabromodiphenyl Ether (deca-BDE): Deca-BDE is used as a synthetic flame retardant because of its inhibitory effect on the ignition of organic material. It is used by DoD in aerospace, electronics, textiles and plastic applications.

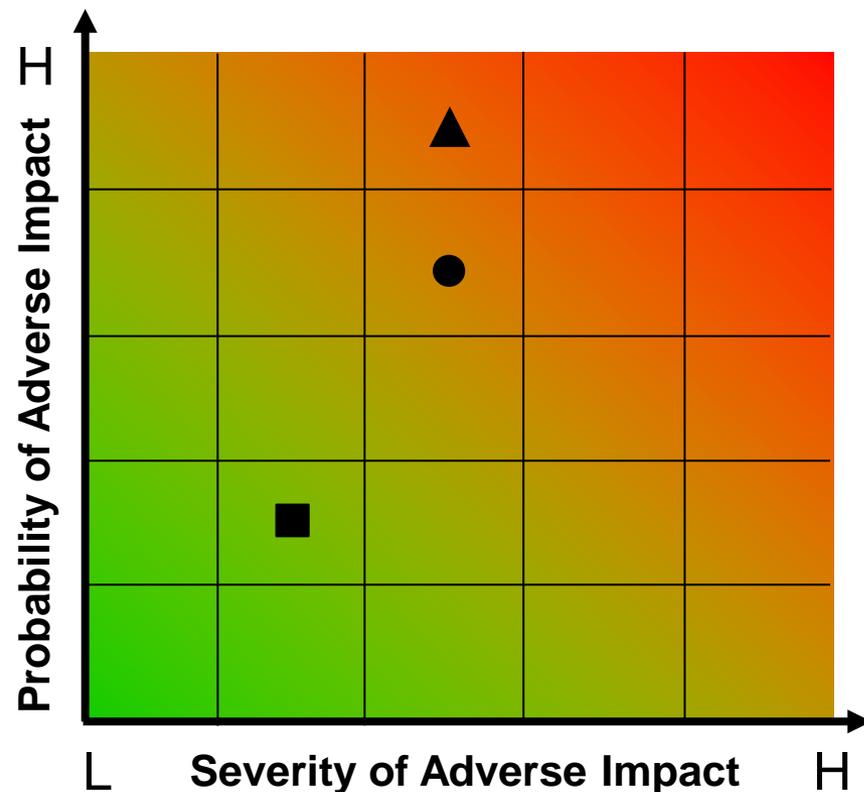
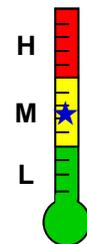
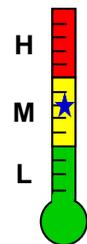
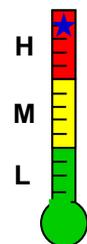
Likelihood of Toxicity Value/ Regulatory Change

1. Likelihood that deca-BDE will be phased out under the USEPA Voluntary Phase-out Program

2. Likelihood that state regulations will further restrict or ban deca-BDE

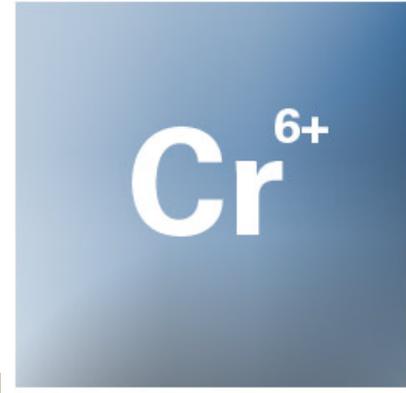
3. Likelihood that deca-BDE will be further regulated or banned under international regulations

Probability



- Readiness & Training ▲ Acquisition/RDT&E
- POMD of Assets

DoD Hexavalent Chromium Minimization



DANGER

HEXAVALENT CHROMIUM CHROMIUM (VI) OR Cr(VI) CANCER HAZARD

CAN DAMAGE SKIN, EYES, NASAL PASSAGES, AND LUNGS. AUTHORIZED PERSONNEL ONLY. RESPIRATORS MAY BE REQUIRED IN THIS AREA.



WANTED

By the Electronics Community for crimes against Planet Earth and its inhabitants.

Hexavalent Chromium

A.K.A.: Calcium Chromate, Chromium Trioxide, Lead Chromate, Zinc Chromate, Strontium Chromate

Atomic Weight: Unknown

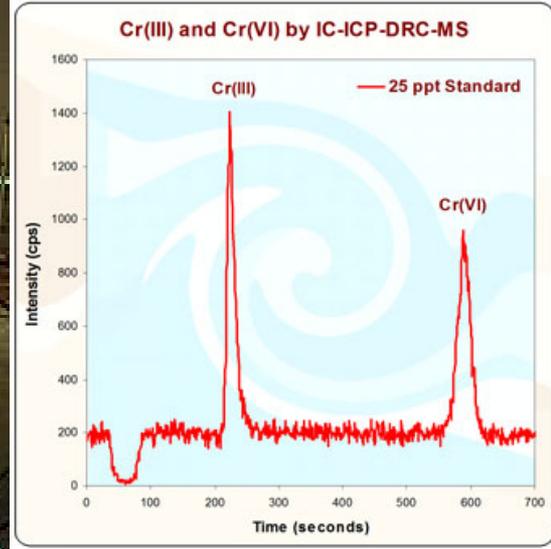
Usually Found In: Spray Paints, Chrome Plating, Coatings, Stainless Steel

Remarks: Hexavalent Chromium and its compounds are found in many workplaces and present one of the greatest workplace hazards around

CAUTION: Hexavalent Chromium is a known Carcinogen and has been linked to a statistically significant increase in lung Cancer, Ulcers and permanent eye damage

SemiconductorStore.com
Leading the "Lead-Free" Revolution

Lead Free



Hexavalent Chromium Risk Management Actions

- **Policy and Regulation**

- ✓ DoD 2009 policy on minimizing use of Cr+6 in DoD weapons systems, platforms, facilities, and equipment
- ✓ DoD Risk Alert, January 2011
- ✓ DFARs amended to prohibit Cr+6-containing items in materials acquired by the DoD unless there is no acceptable alternative

- **Develop accelerated corrosion testing protocol that more accurately reflects DoD operational environments**

- **Substitute Materials**

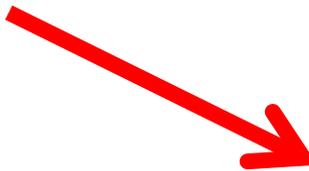
- ✓ Identify barriers to using non-Cr+6 alternatives
- ✓ Develop database of proven Cr+6 substitutes
- ✓ Develop database¹ of test protocols, test results, technical authorizations, implementation status and lessons learned with Cr+6 alternatives



**Technician loading test panels
into salt-fog (salt spray) test cabinet
(ASTM B117)**

¹ SERDP/ESTCP Advanced Surface Engineering Technologies for a Sustainable Defense – <http://assetsdefense.org/>

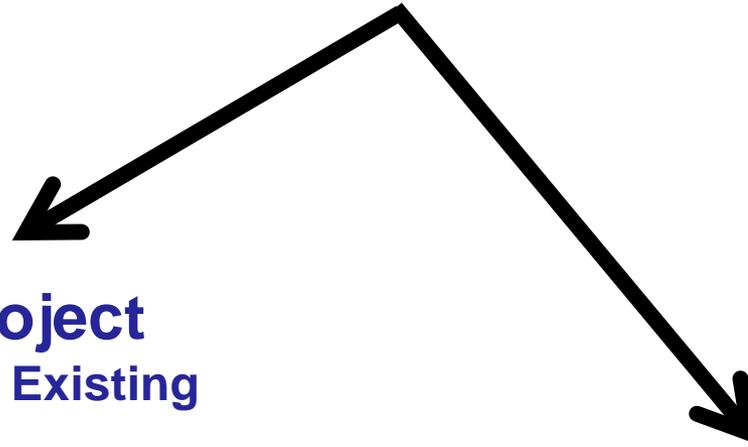
Desired DoD Paradigm Shift for Cr⁶⁺

- ❖ **Default use of Cr⁶⁺**
 - ❖ **“Promotion” of substitutes**
 - ❖ **Can result in business as usual**
- 
- ❖ **Default use of substitutes**
 - ❖ **Use of Cr⁶⁺ if no substitute can meet performance requirements**
 - ❖ **Bias for change**

Note: The required performance shouldn't be based on Cr⁶⁺ but on a level of acceptable performance for the application

Three Part Cr⁶⁺ Strategy

Cr⁶⁺ Minimization Policy
USD(AT&L) memo of 8 April 2009
Sets the Desired Course



Legacy Project
Minimize Cr⁶⁺ in Existing
Specs

Defense Federal Acquisition Rule
Minimizes Cr⁶⁺ in New Acquisitions

How Many Specifications Reference Cr⁶⁺?

Results from ASSIST database searches:

Revision	Number of Documents
Initial ASSIST search	5,356
Multiple revisions of same specification removed	4,277
Duplicate documents removed	3,419
Active documents only (inactive, cancelled, and withdrawn documents removed)	1,418
DoD documents only (MIL-SPECs, MIL-STDs, and MIL-HDBKs)	779

Eliminated about 4,500 documents by removing revisions, duplicates, inactive/cancelled/withdrawn specs, and non-DoD documents.

Cr⁶⁺ Case Study – Low Hanging Fruit

- ❖ **Two specifications identified for revision**
 - ◆ Black oxide and phosphate coatings
- ❖ **Cr⁶⁺ free substitutes widely used in industry**

Specifications	FSGs	FSCs	NSNs	No. of Weapon Systems
MIL-DTL-13924	22	49	339	275
MIL-DTL-16232	25	70	3118	473

Hex Chrome Strategy Implementation Status

- **Worked with industry & DoD experts to identify substitutes**
- **Held DoD-industry roundtable to “ground-truth” whether substitutes will meet performance requirements**
- **Working directly with specification “owner” to revise specification for non-Cr⁶⁺ processes**
- **Substitutes meeting test requirements to be placed on Qualified Products List**

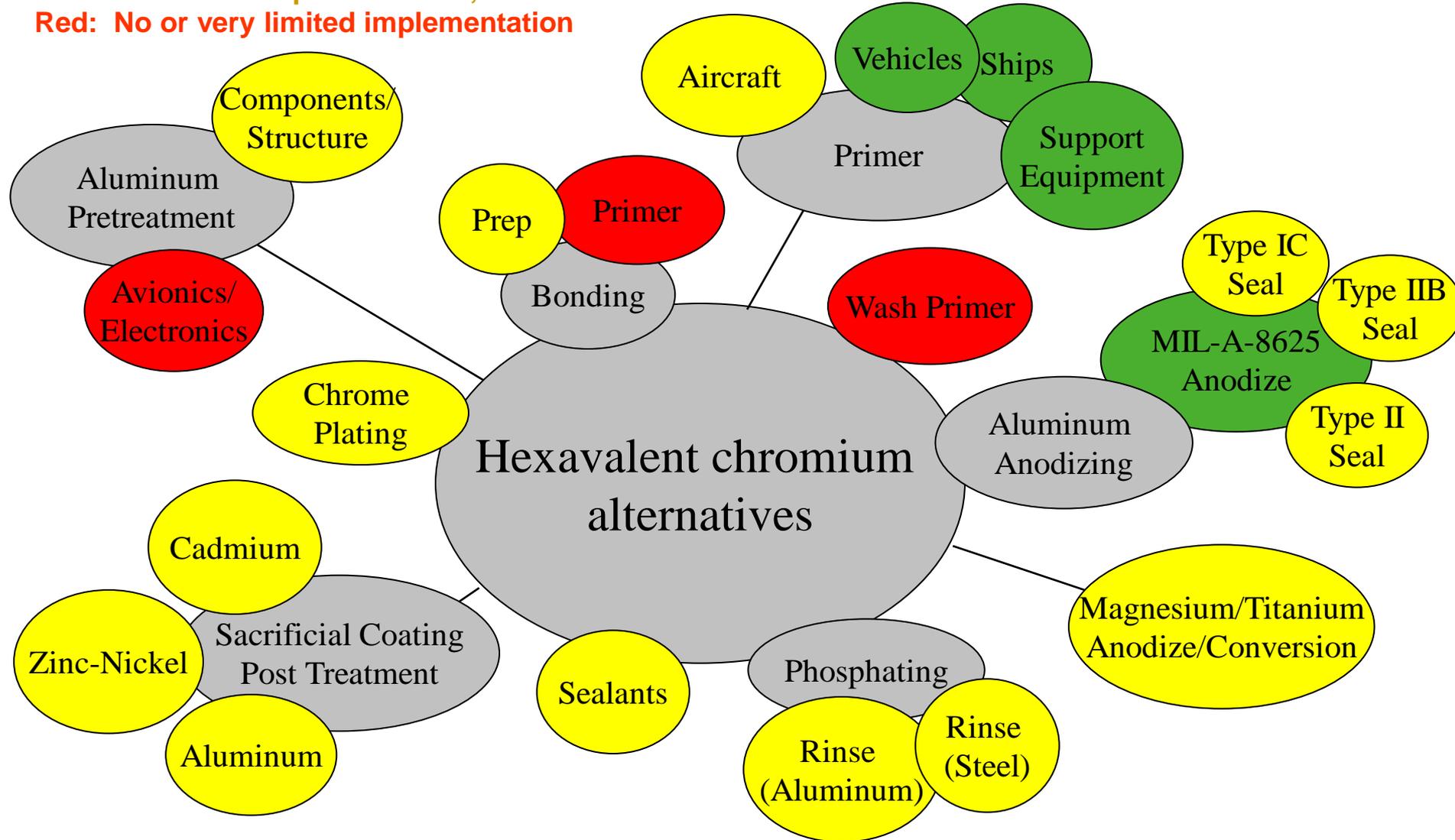
Application Areas for Chromate Alternatives

Slide courtesy of NAVAIR

Green: Alternatives implemented; niche chromate use remains

Yellow: Limited implementation; near-term validation

Red: No or very limited implementation



SERDP/ESTCP Initiative



- ❖ Numerous surface-engineering-related projects executed by SERDP, ESTCP and other organizations to develop and evaluate new technologies that are more environmentally friendly and reduce life-cycle costs
- ❖ Problem is that stakeholders and weapons systems owners do not have ready access to data to determine if new technology can be implemented
- ❖ ASETSDefense is an initiative intended to develop information data bases and organize workshops associated with technologies in the surface engineering field; web site www.asetdefense.org is entry point to engineering data and materials selection data bases under development

Watch List – September 2013

- ✓ Tungsten/alloys
 - ✓ 1,4-dioxane*
 - ✓ Metal Nanomaterials
 - ✓ Carbon Nanomaterials
 - ✓ Perfluorooctyl sulfonate (PFOS)
 - ✓ Perfluorooctanoic acid (PFOA)
 - ✓ Di-nitrotoluenes (DNT)
 - ✓ Nickel
 - ✓ Cadmium
 - ✓ Manganese
 - ✓ 5-Nitro-1,2,4-triazol-3-one (NTO)
 - ✓ 1-Bromopropane
 - Cobalt
 - 2,4 dinitroanisole (DNAN)
 - Antimony
 - ✓ N-propyl bromide
 - ✓ N-Nitrosodimethylamine (NDMA)
 - ✓ Diisocyanates
 - ✓ TCE ...moved from action list
 - ✓ Perchlorate ...moved from action list
 - ✓ decaBDE
 - ✓ Vanadium & compounds
 - ✓ Dioxins
- ✓ Phase I Impact Assessment completed

* To be re-assessed

EC Action List – September 2013

- ✓ **Royal Demolition eXplosive (RDX)**

 - Cyclotrimethylenetrinitramine

- ✓ **Hexavalent Chromium (Cr⁶⁺)**
- ✓ **Naphthalene**...pending downgrade to watch list
- ✓ **Beryllium (Be)**
- ✓ **Sulfur Hexafluoride (SF6)**
- ✓ **Lead**
- ✓ **Phthalates**

- ✓ **Phase II Impact Assessment completed.**

Program Scorecard – Cumulative

- ❖ **Potential ECs screened --- 593**
- ❖ **Phase I Impact Assessments completed --- 27**
- ❖ **Phase II Impact Assessments completed --- 10**
 - ◆ All current/former action list chemicals completed.
- ❖ **56 Risk Management Options (RMOs) developed & turned into Risk Management Actions (RMAs)**
 - ◆ 30 completed, 19 in-progress, 4 pending, 3 deferred

Way Forward

- **Apply continuous process improvement.**
- **Provide solutions to issues presented by emerging contaminants across the lifecycle.**
- **Examine additional risk management options to mitigate, eliminate, or transfer risk.**



Phase I Impact Assessment Results Summary

2006-2013

Recommended for Watch List

- ❖ 1-Bromopropane (1-BP)
- ❖ Cadmium and Compounds
- ❖ Cerium ***
- ❖ Cobalt and Compounds
- ❖ Decabromodiphenyl Ether (deca-BDE)
- ❖ Diisocyanates
- ❖ Dinitrotoluenes (DNT)
- ❖ 1,4-Dioxane
- ❖ Dioxins
- ❖ Manganese and Compounds
- ❖ Nanomaterials (Metal- and Carbon-Based)
- ❖ Nickel
- ❖ NTO
- ❖ Perfluorooctyl Sulfonate (PFOS)
- ❖ Tetrachloroethylene (PCE) ***
- ❖ Tungsten
- ❖ Tungsten Alloy
- ❖ Vanadium and Compounds

Determining Need for Phase I Assessment

- Antimony

Dropped After Phase I

- ❖ Dichlorobenzenes
- ❖ Polybrominated diphenyl ethers (PBDEs)
- ❖ 1,2,3-Trichloropropane (TCP)

Recommended for Phase II / Action List

- ❖ Beryllium
- ❖ Hexavalent Chromium
- ❖ Lead
- ❖ Naphthalene
- ❖ Perchlorate *
- ❖ Perfluorooctanoic Acid (PFOA) **
- ❖ Phthalate Esters
- ❖ RDX
- ❖ Sulfur Hexafluoride (SF6)
- ❖ Trichloroethylene (TCE) **

Future Assessments (anticipated date)

- ❖ DNAN (February 2014)
- ❖ 1,4-Dioxane (Inhalation only) (TBD)
- ❖ Cobalt (pending IRIS review) (TBD)

* Demoted to Watch List in September 2010

** Subsequent Phase II Impact Assessment recommended delisting from the Action List and adding to the Watch List *** Regulatory developments supported delisting from the Watch List