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National Security Implications of EPA IRIS and TSCA Activities for Formaldehyde and Other Critical Minerals

Briefing for Mr. Jack Bergman, U.S. House of Representatives, and the Committee on Armed Services of the House of Representatives pursuant to Request from Mr. Jack Bergman, U.S. House of Representatives

February 2024

The estimated cost of this report or study for the Department of Defense is approximately $17000 for the 2024 Fiscal Year. This includes $15,000 in expenses and $2250 in DoD labor.
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Purpose

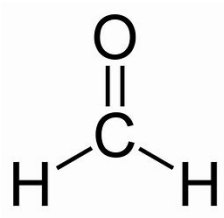
- Mr. Jack Bergman, U.S. House of Representatives, requested the Secretary of Defense and the Environmental Protection Agency (EPA) Administrator to provide a briefing on the national security implications of EPA Integrated Risk Information System (IRIS) and Toxic Substances Control Act (TSCA) activities for formaldehyde and other critical minerals. (Letter from Mr. Jack Bergman to HON Lloyd Austin III, Secretary of Defense, and HON Michael Regan, EPA Administrator, dated September 18, 2023.)

Briefing Topics

- **Background and DoD Uses for Chemicals Subject to Future EPA TSCA Regulations:**
  - Formaldehyde
  - Vanadium
  - Uranium
- **EPA IRIS Program**
- **TSCA Section 6 Regulatory Process**
- **Executive Order (E.O.) 12866 Interagency Review**
- **Conclusion**

Formaldehyde Background

Formaldehyde is a colorless, flammable gas at room temperature that is found in, or used to produce, many products.



Identified DoD Applications:

- Paints, primers, adhesives, cleaning solvents, disinfectants, military uniforms, in the production of landing gear components, lubricants for extreme hot and cold temperatures, brake pads, door and window insulation for military aircrafts, epoxy, insulating compounds, resins, varnish, molding compounds, hydraulic fluids, insulating varnish, water sampling tests, select weapon system coatings and sealants, building materials (engineered lumber, strandboard, plywood, laminates), and embalming fluids.
- Used during the manufacture of printed circuit boards, electrical and electronics-related applications.
- Used to produce hexamine which is used to produce RDX (Royal Demolition eXplosive) and other explosive compounds with widespread DoD uses.

Formaldehyde Use in DoD Standards

Active DoD Specification	Document Title
MIL-B-1860E NOT 1	Buckle, Slide, Plastic
MIL-PRF-23714D	Kits, Sampling, for Aviation Fuels, Reusable
MIL-DTL-28950C	Coat, Man's - Dress; Blue (Officer's)
MIL-C-43157(4)	Cloth, Spun Viscose Rayon, Resin Impregnated
MIL-DTL-46110C NOT 2	Coating Compound, Oxide Black
A-A-3007A	Thinner: for Phenol-Formaldehyde and Medium Oil and Styrenated Alkyd Paints and Varnishes
A-A-59339 NOT 1	Guanidine Nitrate
A-A-59342 NOT 4	Ethyl Alcohol (for Ordnance Use)
A-A-59994	Button, Sewing Hole, and Button, Staple, (Plastic)
MIL-HDBK-406(2) NOT 3	Contamination Control Technology Cleaning Materials for Precision Precleaning and Use in Clean Rooms and Clean Work Stations
MIL-HDBK-407(1) NOT 3	Contamination Control Technology Precision Cleaning Methods and Procedures
ASTM-D704	Melamine-Formaldehyde Molding Compounds
ASTM-D2194	Concentration of Formaldehyde Solutions
ASTM-D4690	Adhesive, Uvea-Formaldehyde Resin
SAE-AMS3607	Plastic Sheet Cotton Fabric Reinforced Phenol-Formaldehyde
SAE-AMS3615	Tubing, Plastic, Cotton Fabric Reinforced Phenol-Formaldehyde

- DLA ASSIST lists 16 active standards that use, or call for, formaldehyde use in resins, surface coatings, adhesives, molding compounds, fungicides, and test methods for product conformance.

Formaldehyde Critical Uses Associated with Defense Industrial Base and Aerospace

NASA

- Calibration of formaldehyde sensors for airborne and satellite-based measurements.
- Analysis of extraterrestrial material samples.

Aerospace Industries Association (AIA)

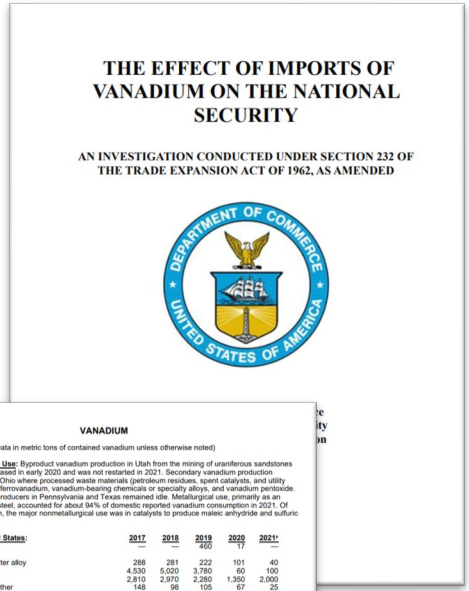
- "Specific aerospace industrial uses include, but may not be limited to: primers (epoxy, epoxy-polyamide), numerous polyurethane topcoats, adhesive bond primers, wash primers, general purpose and fuel tank sealants (polysulfides), dry film lubricants (including molybdenum disulphide), graphite paste, electrical insulators, adhesives (including rubber and structural film for sandwich construction), lubricants, lubricating oil, hydraulic fluids (petroleum based, and fire resistance hydrocarbon based), marking inks, and epoxy and phenolic resins used in preimpregnated fiber composites."

American Chemical Council (ACC) Formaldehyde TSCA Risk Evaluation Consortium

- "Formaldehyde's unique and versatile chemical properties make it an essential building block technology for modern life. For example, in multiple industry sectors (e.g., construction, automotive, aerospace and health care) products that are based on formaldehyde technologies have broad roles in the economy, supporting approximately 995,000 jobs in the United States and providing essential products and services."

Vanadium Background

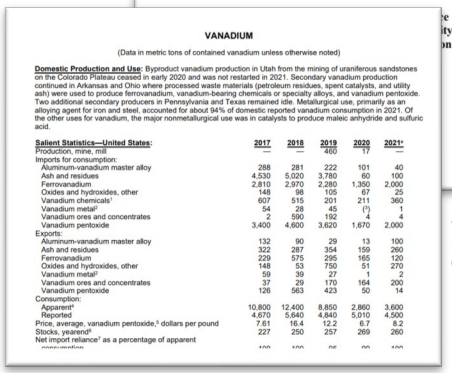
- **Vanadium is a malleable transition metal primarily used to enhance the strength and durability of steel.**
- Vanadium is also used in titanium alloys for the aerospace and military sectors, catalysts for reducing nitrogen oxides in industrial power plants and in the production of sulfuric acid, and in large-scale batteries.
- Other uses of vanadium include longwave infrared imaging, pigments for paints and coatings, lubricant oils, and pharmaceuticals.
- The domestic vanadium industry is almost entirely reliant on importation, with three countries leading the global supply chain.


THE EFFECT OF IMPORTS OF VANADIUM ON THE NATIONAL SECURITY

AN INVESTIGATION CONDUCTED UNDER SECTION 232 OF THE TRADE EXPANSION ACT OF 1962, AS AMENDED

DEPARTMENT OF COMMERCE · UNITED STATES OF AMERICA

Source: US Department of Commerce

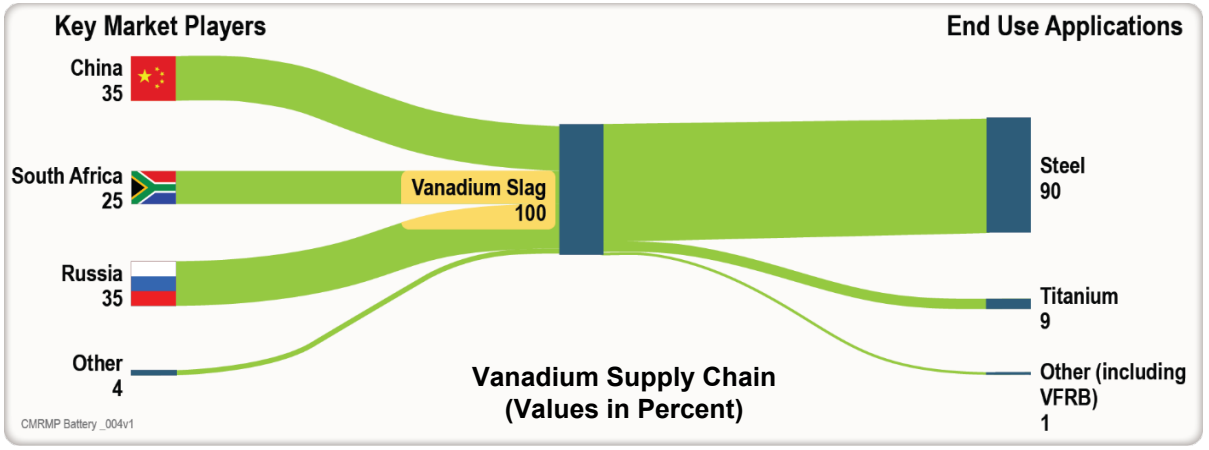

VANADIUM

(Data in metric tons of contained vanadium unless otherwise noted)

Domestic Production and Use: Byproduct vanadium production in Utah from the mining of uraniferous sandstones on the Colorado Plateau ceased in early 2020 and was not restarted in 2021. Secondary vanadium production continued in Arkansas and Ohio where processed waste materials (petroleum residues, spent catalysts, and utility ash) were used to produce ferrovanadium, vanadium-bearing chemicals or specialty alloys, and vanadium pentoxide. Two additional secondary producers in Pennsylvania and Texas remained idle. Metallurgical use, primarily as an alloying agent for iron and steel, accounted for about 94% of domestic reported vanadium consumption in 2021. Of the other uses for vanadium, the major nonmetallurgical use was in catalysts to produce maleic anhydride and sulfuric acid.

Salient Statistics—United States:	2017	2018	2019	2020	2021e
Production, mine, mill	—	—	400	17	—
Imports for consumption:					
Aluminum-vanadium master alloy	288	281	222	101	40
Ash and residues	4,530	5,020	3,780	60	100
Ferrovanadium	2,810	2,970	2,280	1,350	2,000
Oxides and hydroxides, other	148	98	105	67	25
Vanadium chemicals[1]	607	515	201	211	360
Vanadium metal[2]	54	28	45	(r)	1
Vanadium ores and concentrates	2	590	192	4	4
Vanadium pentoxide	3,400	4,600	3,620	1,670	2,000
Exports:					
Aluminum-vanadium master alloy	132	90	29	13	100
Ash and residues	322	287	354	159	260
Ferrovanadium	229	575	295	165	120
Oxides and hydroxides, other	148	53	750	51	270
Vanadium metal[2]	59	39	27	1	2
Vanadium ores and concentrates	37	29	170	164	200
Vanadium pentoxide	126	563	423	50	14
Consumption:					
Apparent[3]	10,800	12,400	8,850	2,860	3,600
Reported	4,670	5,640	4,840	5,010	4,500
Price, average, vanadium pentoxide,[4] dollars per pound	7.61	16.4	12.2	6.7	8.2
Stocks, yearend[2]	227	250	257	269	260
Net import reliance[5] as a percentage of apparent					

Source: United States Geological Survey



Vanadium Background *(cont.)*

- **Vanadium is listed as a strategic and critical material by the Defense Logistics Agency.**
- **The steel industry accounts for 90-93% of total vanadium use.**
  - High-strength, low-alloy (HSLA) steel products are used in shipbuilding and other defense uses such as armor plating.
  - High speed steel is used on aerospace applications such as gas engine turbines (at concentrations exceeding 5% vanadium).
- **Use in titanium alloys accounts for 3-5% of total vanadium use.**
  - Currently there are no acceptable substitutes for vanadium in aerospace titanium alloys.

Table 1. Uses of Alloys and Steel in Weapon Systems

Application	Impacted Weapon Systems	Composition
Ti-6Al-4V alloy	F-22A Raptor	Contains at least six separate titanium alloys, some containing as much as **15% vanadium by weight**.
	Boeing 787 airframe	Titanium accounts for **approximately 14% of the weight**.
	F-35 Lighting II	Requires an estimated **15 tons of titanium per plane** to build.
Defense Steel	Aircraft Carriers	DoD's steel requirements amount to 3% of annual overall U.S. steel production, equivalent to approximately **230 metric tons of vanadium content per year**.
	Submarines	
	Tanks	
	Aircraft	

Source: US Department of Commerce - https://www.bis.doc.gov/index.php/documents/section-232-investigations/2793-vanadium-section-232-report-public-with-appendices/file

Vanadium Use in DoD Standards

Active DoD Specification	Title
MIL-S-24502C	Steel, Chromium- Molybdenum-Vanadium Bars
MIL-L-48772A NOT 5	Lithium (for Use in Ammunition)
MIL-V-48773(2) NOT 5	Vanadium Pentoxide (For use in Ammunition)
ASTM-A231/A231M	Chromium-Vanadium Alloy Steel Spring Wire
ASTM-A232/A232M	Chromium-Vanadium Alloy Steel Valve Spring Quality
ASTM-A572/A572M	Steel, High-Strength Low-Alloy Columbium-Vanadium Structural
ASTM-D3373	Standard Test Method for Vanadium in Water (for NPDES compliance)

- DLA ASSIST listed seven active DoD standards requiring vanadium use in ammunition, structural components, or laboratory use.

NPDES – National Pollutant Discharge Elimination Systems

Uranium Background

Uranium is a naturally occurring, radioactive metal used to power commercial nuclear reactors that produce electricity and to produce isotopes used for medical, industrial, and defense purposes around the world.

Uranium exists in multiple isotopes, making them ideal for different applications:

- **Natural Uranium** – can be used in converter and breeder reactors.
- **Low Enriched Uranium (LEL)** – most commercial reactor fuel uses LEU enriched to between 3 and 5% 235U. Uranium between 3 and 5% 235U is sometimes referred to as "reactor-grade uranium."
- **Highly Enriched Uranium (HEU)** – used **in naval propulsion reactors (submarines, aircraft carriers), nuclear weapons and in some research reactors**.
- **Depleted Uranium** – contains a 235U concentration of 0.711% or less. It is a co-product of the enrichment process. Depleted uranium can be **used as ballast for ships, counterweights for aircraft, and used in ammunition and armour**.

EPA IRIS Program Process

Office of Research and Development

EPA's Integrated Risk Information System

IRIS Assessment Plans, Protocols, and 7-Step IRIS Process

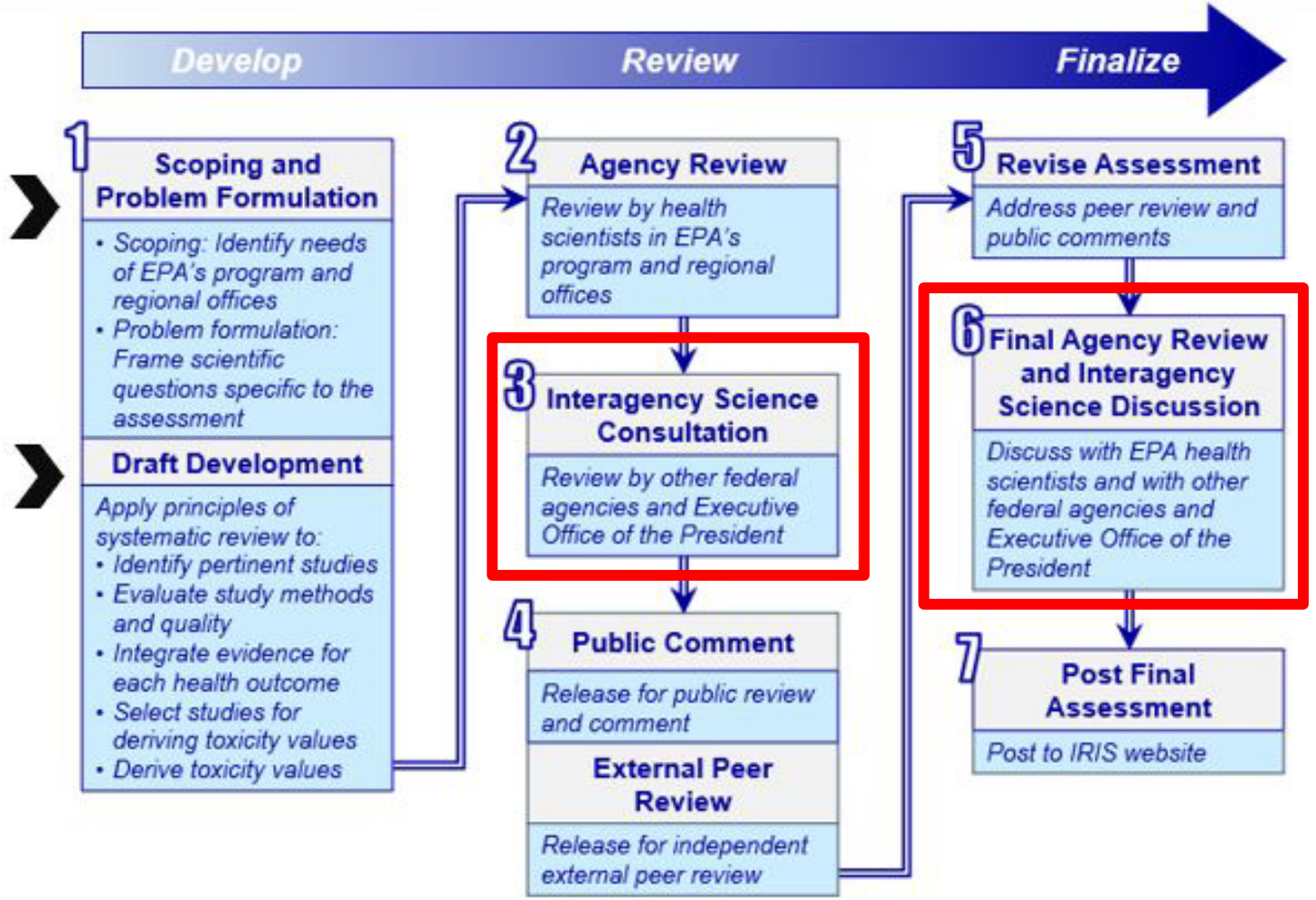
IRIS Assessment Development Process

Early Step 1 - Release IRIS Assessment Plans:

- What the assessment covers released for public comment and discussion at a public meeting

Mid-Step 1 – Release Systematic Review Protocols:

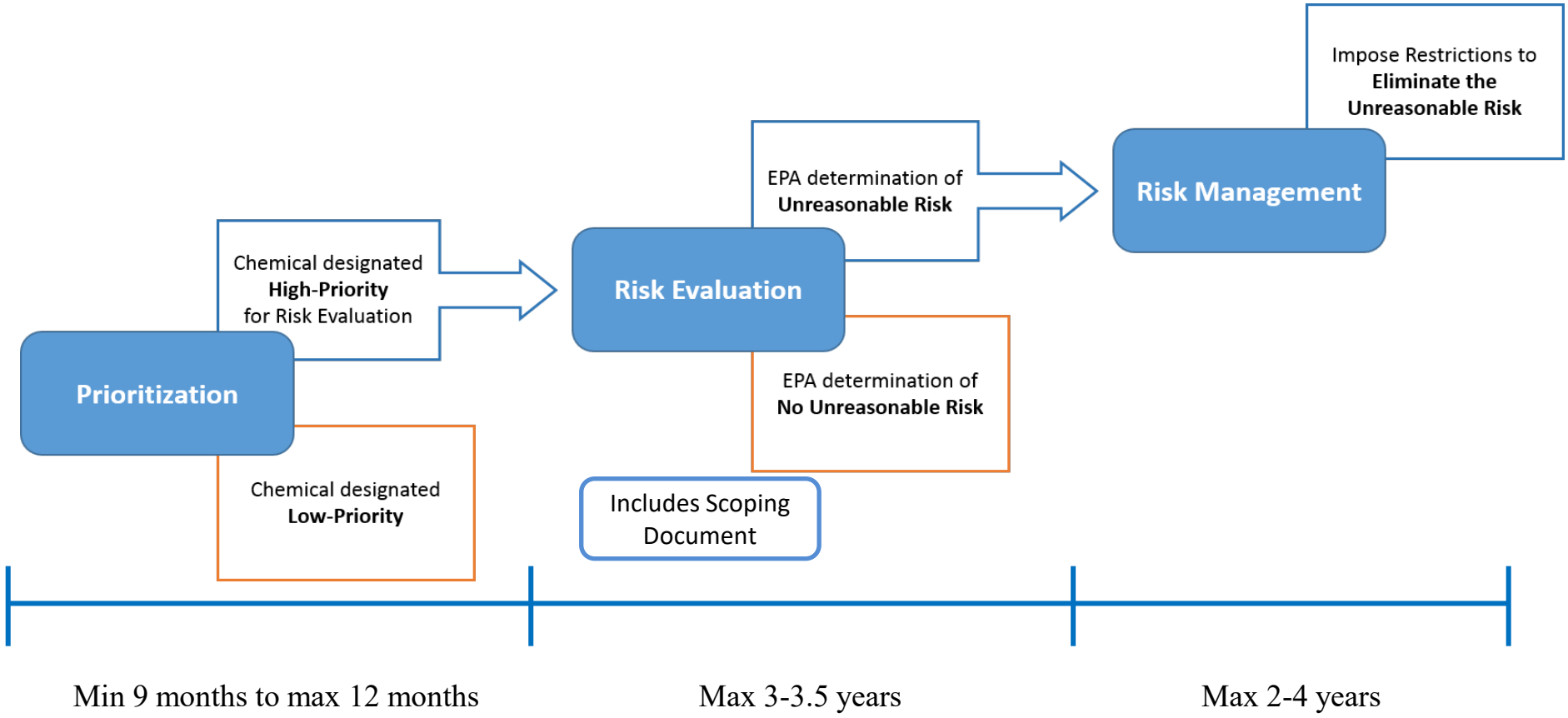
- How the assessment will be conducted released for public comment



DoD IRIS Review Comments – Formaldehyde, Vanadium and Compounds (Oral), and Uranium

- **Formaldehyde**
  - **Available DoD Comments on IRIS Toxicological Review of Formaldehyde – Inhalation (Interagency Science Consultation Draft):** https://cfpub.epa.gov/ncea/iris_drafts/recordisplay.cfm?deid=353316
    - *Next opportunity for DoD review is the Final Toxicological Review, projected release in FY2024.*
- **Vanadium**
  - **Available DoD Comments on IRIS Assessment Plan for the Vanadium and Compounds (Oral) Assessment**: https://www.regulations.gov/comment/EPA-HQ-ORD-2020-0183-0017
  - **Available DoD Comments on Systematic Review Protocol for the Vanadium and Compounds (Oral) IRIS Assessment**: https://www.regulations.gov/comment/EPA-HQ-ORD-2020-0183-0029
    - *Next opportunity for DoD review is the Draft Toxicological Review (Oral), projected release in FY2025. Projected date for Draft Toxicological Review (Inhalation) is TBD.*
- **Uranium**
  - **Available DoD Comments on IRIS Assessment Plan for Uranium (Scoping and Problem Formulation Materials):** https://www.regulations.gov/comment/EPA- HQ-ORD-2017-0747-0008
    - *Next opportunity for DoD review is the Systematic Review Protocol, projected release in FY2024, Q2.*

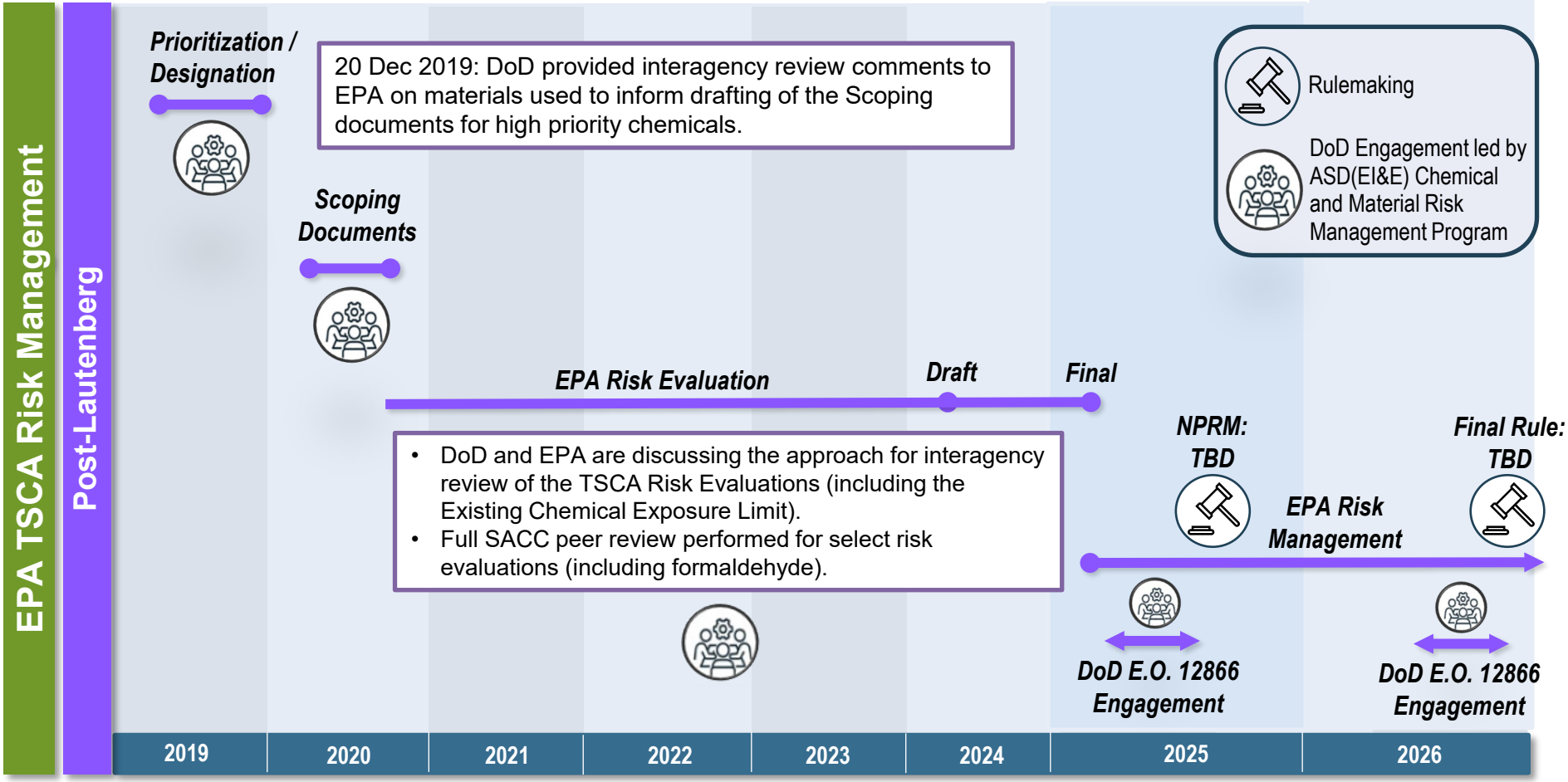
EPA TSCA §6 Process



EPA process and timelines for prioritizing and evaluating the risks of existing chemicals.

https://www.epa.gov/sites/default/files/2017-11/documents/final_pre-prioritization_-_discussion_document_11.13.17.pdf

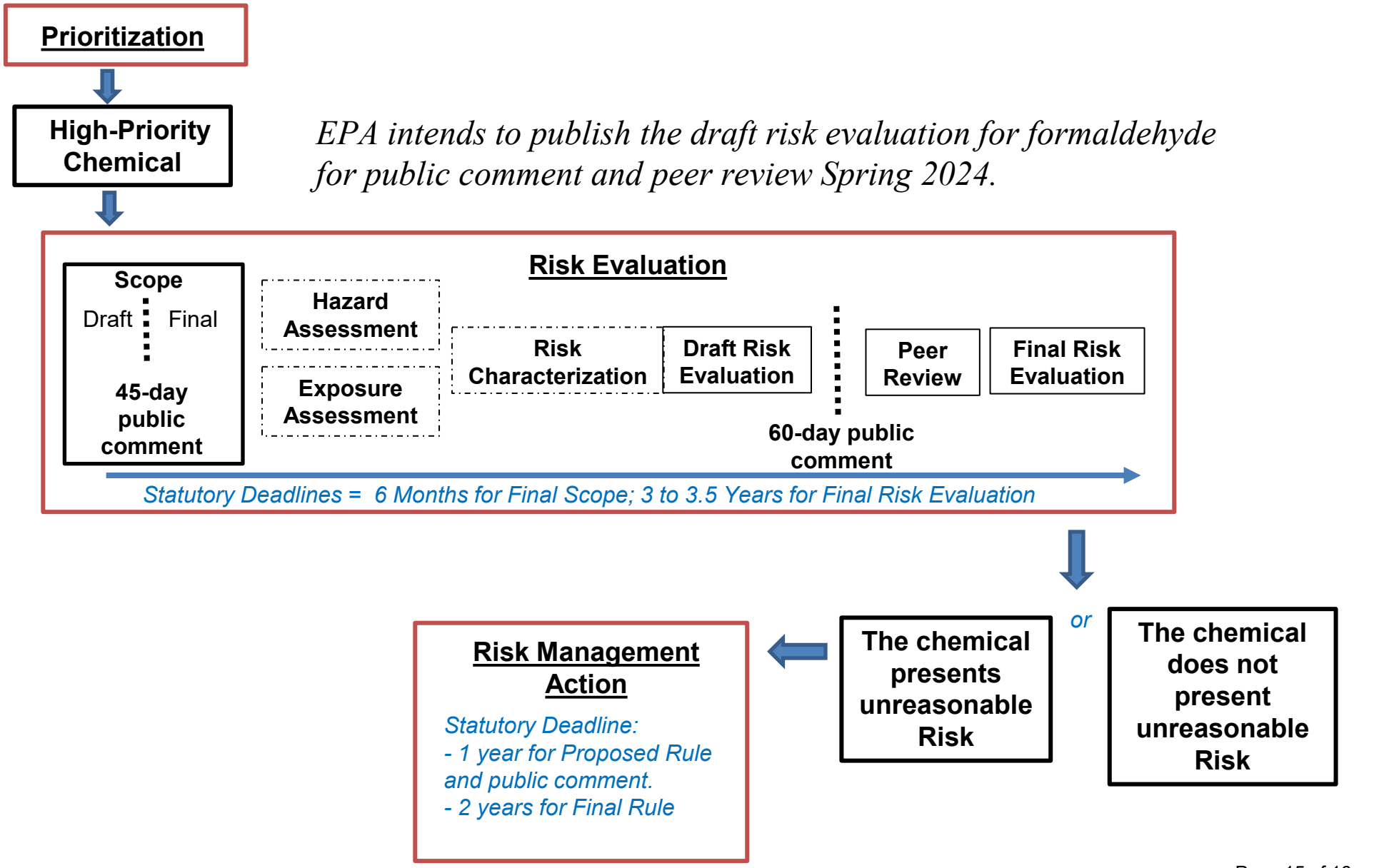
EPA TSCA §6
E.O. 12866 Interagency Review Process



Timeline for EPA TSCA §6 Risk Evaluation and Risk Management for Formaldehyde

ASD(EI&E) – Assistant Secretary of Defense for Energy, Installations, and Environment
NPRM – Notice of Proposed Rulemaking
SACC – Science Advisory Committee on Chemicals

EPA TSCA Risk Evaluation Process



Conclusion

- Formaldehyde, vanadium, and uranium have mission critical applications for defense.
- EPA provides opportunities for engagement with Federal Agencies during the Prioritization, Risk Evaluation Scoping, Draft and Final Risk Evaluations with the intention to assure that the assessment reflects DoD and other Federal Agency uses and any exposure information that can be built into the assessment.
- EPA meets with interagency stakeholders approximately every 2 months to provide opportunities for EPA to provide status updates and facilitate collaboration on risk evaluations. Engagement is particularly focused on chemical use by other Federal Agencies. In addition to these meetings, EPA meets regularly with DoD to ensure an understanding of chemical uses and working conditions.
- DoD will provide E.O. 12866 interagency review comments during the TSCA risk management rulemakings.
- DoD engages in the Interagency Review Process to review best science practices and provide comments in ongoing IRIS assessments.