DEPARTMENT OF ECOLOGY

INTEROFFICE MEMORANDUM

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TO: Jonathan Jennings, HWTR Regulatory Assistance Unit (RAU) Supervisor

FROM: Jerry French and Katy Harvey, Regulatory Analysts, HWTR RAU

SUBJECT: Lithium-Ion Battery Management under Chapter 173-303 WAC, Dangerous Waste Regulations

Background

Ecology developed this memorandum to clarify how the Dangerous Waste Regulations[1] for universal waste and recycling apply to lithium-ion batteries. Due to their ignitable and reactive properties, lithium-ion batteries have resulted in fires and caused significant injury to human health and property. They can also exhibit high pH alkaline corrosivity when mixed with water at a fire incident. Spent lithium-ion batteries generated by *businesses* are subject to the Dangerous Waste Regulations and must be handled and recycled safely. This document helps clarify how end-of-life battery management is regulated by the Department of Ecology.

Frequently Asked Questions on Lithium-Ion Battery Management

1. **When do used batteries become solid waste?**

   Used batteries are solid waste at the point of generation. For example, when the battery:

   - Becomes a **spent material** - Spent material means any material that has been used and as a result of contamination[2] can no longer serve the purpose for which it was produced without processing.
   - Has reached **end of life** - End of life means the battery will no longer be used for its intended purpose. This may include but is not limited to: when the battery is discarded, a decision has been made to discard, or when a battery pack has been disassembled to facilitate storage, transportation, or processing.

2. **Are all used batteries solid waste?**

   No – Not all used batteries are considered end-of-life. Some used batteries still have energy capacity and may be used or reused in other applications. These reusable batteries are not solid waste under WAC 173-303-017(2)(a)(ii)[3] - Used or reused as effective substitutes for commercial products.

3. **If lithium-ion batteries are destined for reuse after being taken out of service, such as removed from electric vehicles, are they solid waste?**

   Although batteries taken out of service may no longer be efficient to power a car, they often still have about 70% of the original energy capacity and can be used for other applications. Batteries are often repurposed

[1] Chapter 173-303 WAC: https://apps.leg.wa.gov/WAC/default.aspx?cite=173-303

[2] For batteries, contamination includes a breakdown in the chemical flow of charged ions which become less effective over time and eventually will render the battery unusable.

[3] https://app.leg.wa.gov/WAC/default.aspx?cite=173-303-017

for “second life” energy storage uses in electrical grids and communications towers, as well as energy storage for solar farms, wind farms, and other renewable sources. These batteries aren’t solid waste under WAC 173-303-017(2)(a)(ii)[4] - Used or reused as effective substitutes for commercial products.

4. What is a battery?

"Battery" means a device consisting of one or more electrically connected electrochemical cells which is designed to receive, store, and deliver electric energy.

An electrochemical cell is a system consisting of an anode, cathode, and an electrolyte, plus such connections (electrical and mechanical) as may be needed to allow the cell to deliver or receive electrical energy.

The term battery also includes an intact, unbroken[5] battery from which the electrolyte has been removed.

5. What's the difference between a lithium-metal and lithium-ion battery?

Lithium-metal batteries are single-use and non-rechargeable, also referred to as a *primary battery*. Common products that use lithium metal batteries include vehicle key fobs, watches, remote controls, and smoke detectors.

Lithium-ion batteries are a type of *secondary battery* which consist of rechargeable lithium-polymer cells. Lithium-ion batteries are typically found in electric vehicles, e-cigarettes, power tools, cameras, laptops, and cell phones. Common lithium-ion battery chemistries include:

- Lithium Nickel Manganese Cobalt Oxide
- Lithium Nickel Cobalt Aluminum Oxide
- Lithium Iron Phosphate
- Lithium Cobalt Oxide
- Lithium Manganese Oxide
- Lithium Titanate

6. Do lithium-ion batteries designate as dangerous waste?

Although several battery chemistries exist on the market, most lithium-ion batteries designate as dangerous waste for reactivity (D003), ignitability (D001), or both.

7. Can lithium-ion batteries be managed as universal waste in Washington?

Yes, generators have the option to recycle dangerous waste batteries under the less stringent universal waste standards in WAC 173-303-573, rather than managing them as fully regulated dangerous waste. Sites who generate used batteries are called universal waste handlers and the regulations define two separate categories: 1) small quantity handler and 2) large quantity handler.

Learn more in Ecology’s Guide to Universal Waste.[6]

8. Can damaged[7] lithium-ion batteries be managed as universal waste in Washington?

Small and large quantity handlers of universal waste must contain any universal waste battery that shows evidence of leakage, spillage, or damage that could cause leakage under reasonably foreseeable conditions in a container.[8] While current state and federal regulations don’t prohibit damaged batteries from being managed as universal waste, Ecology recognizes there are greater fire risks associated with damaged

[4] https://app.leg.wa.gov/WAC/default.aspx?cite=173-303-017
[5] Batteries may not be crushed or broken to remove the electrolyte. *Source: 95-11143.pdf (govinfo.gov) page 25504.*
[6] https://apps.ecology.wa.gov/publications/SummaryPages/2104017.html
[7] The term “damaged” includes, but is not limited to broken, dented, breached or swollen lithium-ion batteries.
[8] **State**: WAC 173-303-573(9)(a)(i) and -573(20)(a)(i) **Federal**: 40 CFR Part 273.13(a)(1) and Part 273.33(a)(1)

lithium-ion batteries. Because of the hazards associated with lithium-ion batteries, Ecology plans to publish guidance for handlers of damaged lithium-ion batteries prior to EPA's upcoming universal waste rulemaking.[9]

9. Can spent lithium-ion batteries be shipped to a recycler out of state?

Yes, the shipper and carrier must transport spent lithium-ion batteries in compliance with all U.S. Department of Transportation (DOT) Hazardous Materials Regulations.

Universal waste batteries that meet the definition of a hazardous material under 49 C.F.R. Parts 171 through 180, are subject to U.S. DOT packaging, labeling, marking and placarding regulations. Universal waste handlers must also prepare the proper shipping papers in accordance with the applicable U.S. DOT regulations.

Strict shipping requirements apply to damaged, defective, and recalled batteries. See U.S. DOT's webpage on Transporting Lithium Batteries.[10]

10. Are any lithium-ion battery recyclers currently operating in Washington?

Washington has several locations that accept used batteries for recycling such as Call2Recycle[11] drop-off sites, retail collection, and permitted moderate risk waste facilities; however, we don't have a lithium-ion battery recycler operating in the state. This means lithium-ion batteries are collected in Washington and sent out of state for recycling.

Multiple battery recyclers operate on the west coast of North America, including but not limited to:

- Redwood Materials[12] (Carson City, NV)
- Cirba Solutions[13] (Trail, British Columbia)
- Kinsbursky Brothers Intl.[14] (Anaheim, CA)

11. How are lithium-ion batteries recycled?

The most common methods currently used to recycle batteries involve dismantling and shredding the whole battery to form black mass. Battery shredding occurs at a universal waste destination facility, **not** a universal waste handler. Black mass is the term the battery recycling industry uses to describe the filter cake-like material made up of the anode and cathode materials when lithium batteries are shredded. Black mass is either melted down (pyrometallurgy) or dissolved in acid (hydrometallurgy). These two treatment methods recover and recycle valuable metals in a battery (Al, Cd, Co, Cu, Li, Ni).

- **Pyrometallurgy** – traditional smelting process/heat treatment to recover and recycle metals.
- **Hydrometallurgy** - process used to extract metals from black mass, which is achieved by recovering and dissolving the metals as salt in successive water-based steps, including leaching, purification, and recovery of the targeted metal by selective precipitation.

[9] https://www.epa.gov/hw/improving-recycling-and-management-renewable-energy-wastes-universal-waste-regulations-solar
[10] https://www.phmsa.dot.gov/lithiumbatteries
[11] https://www.call2recycle.org/Locator/
[12] https://www.redwoodmaterials.com/
[13] https://www.cirbasolutions.com/
[14] https://www.kbirecycling.com/

12. What universal waste management activities can handlers conduct onsite?

Small and large quantity handlers of universal waste may conduct the following activities without becoming subject to the universal waste destination facility requirements:

- Sort batteries by type.
- Mix battery types in one container.
- Discharge batteries so as to remove the electric charge.
- Regenerate used batteries (i.e. restore or recharge the battery to extend its lifespan).
- Disassemble batteries or battery packs into individual batteries or cells.
- Remove batteries from consumer products.
- Remove electrolyte from batteries, as long as the battery cell is closed immediately after electrolyte is removed (i.e. no crushing or shredding allowed).

13. What regulatory requirements would have to be met to recycle, reclaim, and recover lithium-ion batteries as a universal waste destination facility in Washington State?

To comply with universal waste destination facility[15] regulations in WAC 173-303-573(35),[16] the business would have to meet one of the following regulations:

1. Obtain and comply with a RCRA Subtitle C treatment, storage, and disposal facility (TSDF) permit.[17]
   - Including requirements for closure cost estimates WAC 173-303-806(4)(a)(xiii) and financial assurance WAC 173-303-806(4)(a)(xv)

   or
2. Meet the requirements for recycled, reclaimed, and recovered wastes in WAC 173-303-120(4)(c).[18] This is only an option if they recycle universal waste without prior storage (within 72 hours of receipt of waste).
   - WAC 173-303-120 references WAC 173-303-610 for closure cost estimates and WAC 173-303-620 which outlines the financial assurance requirements for these recyclers and reclaimers.

14. What regulatory requirements apply to businesses who recycle universal waste lithium-ion batteries without prior storage in accordance with WAC 173-303-120(4)(c)?

Although a full RCRA Subtitle C Permit isn't required, the regulatory requirements are quite extensive. This includes, but is not limited to:

- Notification, identification numbers, and annual reports.
- Air emission standards
- Performance standards
- Security
- General inspection
- Personnel training

[15] As defined in WAC 173-303-040: https://app.leg.wa.gov/WAC/default.aspx?cite=173-303-040
[16] https://app.leg.wa.gov/WAC/default.aspx?cite=173-303-573
[17] Subject to all applicable requirements of WAC **173-303-140** and **173-303-141**, **173-303-280** through **173-303-525**, **173-303-600** through **173-303-695**, **173-303-800** through **173-303-840**, and the notification requirement at WAC **173-303-060**.
[18] https://app.leg.wa.gov/WAC/default.aspx?cite=173-303-120

- Preparedness and prevention, contingency planning, and emergency procedures
- Manifest requirements
- Facility recordkeeping and reporting
- Closure and financial assurance
- Container and tank standards

HWTR is developing a checklist for universal waste destination facilities who recycle batteries without prior storage in accordance with WAC 173-303-120(4)(c).

15. What steps are required to obtain a TSDF permit?

A TSDF permit[19] establishes the administrative and technical conditions the facility must comply with. It outlines facility design and operation, identifies safety standards, and describes facility performance activities (e.g., monitoring and reporting).

Steps to obtain a permit include:

- The business holds a pre-application meeting with the public.
- Business submits the permit application to Ecology (Parts A and B).
- Ecology reviews application and makes available for public review.
- Ecology issues notice of deficiency to business to revise application.
- Permitting agency drafts the permit for public review.
- Permitting agency makes final decision to grant or deny the permit.

Permits are lengthy (1200+ pages) and the process takes years to complete. Additionally, Washington's Siting Criteria[20] disqualifies most areas in Washington for a potential TSDF operation.

16. What dangerous waste siting criteria are applicable for a proposed lithium-ion battery TSDF?

The siting criteria immediately disqualify proposed dangerous waste facility sites in locations considered unsuitable or inappropriate for the management of dangerous wastes. Businesses proposing to operate a TSDF in Washington must demonstrate compliance with the siting criteria in WAC 173-303-282. A lithium-ion battery dangerous waste facility would define as a nonland-based facility[21] because it is expected to manage waste in containers and tanks. Below is a list of several important siting criteria to consider for a **nonland-based facility**:

Criteria for elements of the natural environment.

- Earth – Seismic risk, subsidence (sinking or subduction), slope or soil instability.
- Air – cannot be in a Class I area or a nonattainment area.
- Surface water – flood, seiche, and tsunami protection. Not located within 100-year flood plain. If located within 500-year flood plain, then requires special design features to prevent flooding of dangerous waste management unit in event of 500-year flood.

[19] https://ecology.wa.gov/Regulations-Permits/Permits-certifications/Dangerous-waste-permits
[20] https://app.leg.wa.gov/WAC/default.aspx?cite=173-303-282
[21] "Nonland based facility" means a facility which does not use the land as an integral part of its waste management method and is not subject to the requirements of WAC 173-303-806 (4)(a)(xxi). These facilities include, but are not limited to, tanks, containers, and incinerators.

- Surface water - Facility boundary located 500 feet away from a perennial surface water body and 500 feet away from nearest surface water intake for domestic water.
- Protection of groundwater and watersheds. Facility dangerous waste management unit boundary located 500 feet away from nearest domestic groundwater intake for domestic water.
- Plants and animals – Facility at least 500 feet from wetlands, critical habitats, natural areas, wildlife refuges.

Criteria for elements of the built environment.

- Adjacent land use – Facility dangerous waste management unit boundary at least 200 feet from nearest point of the facility property line.
- Special land use – cannot be within viewshed of users on wild and scenic rivers. Facility at least 500 feet from state and federal parks, recreation areas, monuments, wilderness areas, prime farmland.
- Residences and public gathering places – Facilities must be located at least 500 feet away.
- Land use compatibility – comply with local land use zoning.
- Archaeological and historical sites – disqualified if area is designated as such by the state or federal government.

17. What upcoming rulemakings will impact spent lithium-ion management?

On October 23, 2023, EPA announced a new rulemaking[22] effort to improve the recycling and management of lithium batteries. EPA is developing a proposed rule to add specific universal waste standards for lithium batteries.

In 2023, the Washington State Legislature passed a law[23] creating a product stewardship program for batteries. This new law requires battery producers to create a statewide collection system for portable used batteries by Jan. 1, 2027. Ecology's Solid Waste Management Program (SWMP) is in the very early stages of implementing this new law. SWMP began rulemaking for this program in late 2023 and more information can be found on our Battery stewardship[24] webpage.

ADA Accessibility

To request an ADA accommodation, contact Ecology by phone at 360-407-6700 or email at hwtrpubs@ecy.wa.gov, or visit ecology.wa.gov/accessibility. For Relay Service or TTY call 711 or 877-833-6341.

[22] https://www.epa.gov/hw/improving-recycling-and-management-renewable-energy-wastes-universal-waste-regulations-solar
[23] https://app.leg.wa.gov/RCW/default.aspx?cite=70A.555
[24] https://ecology.wa.gov/waste-toxics/reducing-recycling-waste/our-recycling-programs/battery-stewardship