



Disposal of Lead-Acid Batteries

White Paper 104

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OBJECTIVE

The objective of this paper is to review the regulatory, legal and financial considerations of proper decommissioning, removal and disposal of Wet Cell and Valve Regulated Lead Acid [VRLA] battery types used in Uninterruptible Power Supply [UPS] systems in accordance with current U.S. federal and state legislation.

BATTERIES USED AS ENERGY STORAGE

The most commonly used lead-acid battery types in UPS systems are flooded cells, also called wet cells referring to their loose electrodes that are immersed in liquid electrolytes. The other is known as Valve Regulation Lead Acid [VRLA] which is a sealed battery, often referred to as maintenance free, given that the electrolytes are encased in a gel or absorptive separator and no liquid is present.



Valve Regulated Lead Acid



Wet Cell/Flooded Battery

Their individual lifespan of lead-acid batteries vary greatly depending on four major factors:

- Ambient Operating Temperature
- Battery Chemistry
- Cycling
- Service and Maintenance

Ambient Operating Temperature

Battery manufacturers rate the output of their batteries based on an ambient operating temperature of 25o C [77o F].

Any variations outside this number will greatly alter the performance of and life of the battery.

A rule of thumb in determining the life of the battery is that for every 8.3o C [15o F] temperature above 25o C [77o F], the life of the battery is reduced by 50%.

Battery Chemistry

Batteries are electrochemical devices whose ability to store and deliver power slowly decreases over time.

Batteries used in UPS applications react to wear and tear in a similar fashion to batteries used in cell phones, laptops, etc. Although battery life and capacity seem to degrade more rapidly and aggressive than that of batteries in UPS applications, it is commonly accepted that batteries for such mobile communication devices seem to have a relatively low lifespan.

Cycling

During a power outage, the UPS is fed DC power from the battery to provide uninterrupted AC supply through the inverter to the critical load. Once power is restored, the UPS will recharge the battery. The process is considered a discharge cycle. A new battery is at 100% rated capacity, however, the frequency and depth [% of rated capacity] of discharge cycles will determine the life of the battery. The more and longer power outages the shorter the battery will last.

Service

The gradual decrease in battery life can be monitored through voltage checks and load testing. A load testing to evaluate the health of the battery requires a discharge cycle that again reduces the life of the battery. Periodic maintenance ensuring proper terminal connections, corrosion removal bad battery cells can reduce the risk of heat-generating resistance on the terminals, improper loading and premature failure.

LEAD-ACID BATTERY RECYCLING

Federal law requires that all used lead-acid [Pb] batteries be managed as Universal Waste under the Code of Federal Regulations [CFR], Title 40 – Protection of Environment, Part 273 – Standards for Universal Waste Management.

Title 261.3 – Definition of Hazardous Waste defines that lead-acid batteries are defined as Hazardous Waste and shall be disposed in accordance with that classification.



Label or placard required by the Department of Transportation for containers or shipments of Hazardous Material.

The CFR simply prohibits the improper disposal of all lead-acid batteries. It is the responsibility of the owner/end user from the date of purchase to the date of disposal to ensure appropriate and legally acceptable method of disposal.

The only legally acceptable method of disposing lead-acid batteries is to recycle them at a Resource Conservation and Recovery Act [RCRA] approved secondary smelter managed under the Environmental Protection Agency [EPA].

GLOBAL HEALTH IMPACT OF IMPROPER BATTERY DISPOSAL

The reason for the strict set of rules governing the disposal of batteries is that lead-acid batteries are largely composed of 60-75% [by weight] lead [Pb], lead-dioxide [PbO₂] and a sulfuric acid solution electrolyte. This heavy metal element makes them toxic and improper disposal can be hazardous to the environment.

Improper and illegal disposal of lead-acid batteries show up in the form of pollution of our drinking water, and food produced from ingredients exposed to small and moderate levels of lead content. Humans are very susceptible to the effects of lead and children are the most vulnerable. Lead's primary target organ is the peripheral nervous system which cause poor growth, delayed learning and reduced intellect. This is also known as lead-poisoning.

An infamous and well-known case in environmental pollution by a company is the 1996 case against Hinkley Compressor Station in Hinkley, CA settled for \$333 million in a lawsuit led by Erin Brockovich and California-based lawyer, Edward L. Masry.

LEGAL IMPACT OF IMPROPER BATTERY DISPOSAL

It is important to understand that as the owner and user of the battery, there is a defined legal exposure to the company.

As in most cases, a company will hire a third party to decommission, remove or dispose or a combination thereof their batteries. Upon contracting with a third party to dispose of the batteries, a Certificate of Recycling should be required containing the following information:

- Contractor name and address
- Battery type and quantity disposed
- Date of removal
- Date of disposal
- Location and number of the EPA certified recycling facility

A Certificate of Recycling will avoid future legal implications to the company in the event the third party contractor does not comply with the law. Without such certificate, and as the owner and user of the battery, the EPA can pursue various legal actions against individuals or the company.

Congress passed a law called the "Mercury-Containing and Rechargeable Battery Management Act" of May 13, 1996 or commonly known as the "Battery Act".

Under this act, the EPA is able to enforce the law and penalize any owner or user, improperly disposing of batteries outside of the Resource Conservation and Recovery Act.

The civil penalty of any individual or corporation violating the act may not exceed \$10,000 per violation, or require immediate compliance at the expense of the violator or a combination of both.

A violation is defined as: "...when on the basis of any information the Administrator determines that a person has violated, or is in violation of, any requirement of this Act..."

A secondary remedy of the EPA for repeat violators or failure to comply with an order issued, may lead to a civil action in the courts.

Separate, and probably greatest, financial concern is knowingly or unknowingly violating the RBRC Act causing harm or damage on third party property including personal injury as a result of lead-poisoning or other health related issues.

History has shown that this is unquantifiable but likely in the millions of dollars of legal exposure should a third party decide to pursue punitive damages in a civil lawsuit.

FINANCIAL IMPACT OF DISPOSING BATTERIES

There are a number of factors directly impacting the cost of disposing batteries in accordance with the RBRC Act.

Batteries are typically deployed in a fully enclosed battery cabinet or on an open rack with various levels of shelves.

The batteries are connected in strings of a number of battery blocks. Each battery block has two terminals that are connected with jumpers from one battery block to the next in the string.

In certain applications, the batteries are secured to the shelves in the rack or cabinet with industrial grade zip ties or other similar means.

A battery system connected to a given UPS, may have one or more strings of batteries depending on the runtime required when originally configured.

There are several companies specializing in recycling of batteries used in various applications, UPS included.

They typically provide a full service offering on a local, regional or national basis servicing clients with a one-time or recurring need to dispose of batteries.

In calculating their quotes to a client they have to consider the following factors:

- Battery type
- Battery weight
- Battery quantity
- EPA legislation specific to the State
- Labor required
 - Disconnecting terminals of batteries
 - Stacking and packaging batteries on pallets
 - Dismantling battery rack or cabinet
 - Removing debris and final clean up
- Location in the building
 - Consider tools or equipment used to move heavy batteries from floor to floor
- Loading dock availability
- Distance from client site to EPA certified recycling facility

- Contracting with Hazardous Material certified driver
- Recycle lead acid batteries as per regulations
- Supply a Certificate of Recycling
- Insurance coverage in accepting responsibility and ownership of batteries destined for recycling

Quotes and rates vary greatly as the factors above change.

This is an example of a VRLA battery solution:

- UPS is sized for 100kVA/80kW
- The battery configuration provides 15 minutes of runtime
- The battery type is 12V/370Ah flame-retardant Valve Regulated Lead Acid battery
- Two strings, each 32 batteries, of 64 batteries complete and connected
- Deployed in an equal number over three shelves in a fully enclosed battery cabinet

The following work is required by the third party contractor decommissioning, removing and disposing the batteries:

- Battery system is de-energized
- No damaged batteries
- Disconnecting batteries
- Moving batteries from battery cabinet to pallet(s)
- Stacking and securing batteries
- Covering and appropriately sealing the pallet(s)
- Batteries are located on the ground floor
- Moving pallet(s) from computer room into a lift-gate truck
- Distance from site of decommissioning to EPA certified recycling facility is approximately 150 miles
- Certificate of Recycling issued
- Proof of pollution liability insurance in excess of \$5,000,000

Total weight of the shipment is ~4,200 lbs.

The cost will be in the range of ~\$2,500 - \$3,000.

Unless the site is ultimately shutdown, the UPS system will require a new replacement battery system at the same time of the disposal of the end-of-life battery system. The cost of the replacement battery system in a similar battery configuration described above is ~\$23,500 including installation and transportation.

CONCLUSION

As described in the paper there are a number of factors to consider when acquiring a battery based system for your UPS system. A part from causing documented harm to the environment leading to global health issues, there are significant financial impacts if not in compliance with the law.

Enforcement of the law can lead to fines and unnecessary expenses relating in clean-up orders.

Personal injury and damage to third party property can leave the company open to million dollar lawsuits in punitive damage, reimbursement and clean-up.

The frequency of battery replacement [described in AP White Paper xxxxx xxxxx xxxxxxx] will significantly decide the overall legal and financial exposure to the company as well as the direct cost of properly disposing the batteries and subsequently replacing for continued operation.

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