Maintaining Compliance in the VRLA Battery Room

Jeff Donato
National Marketing & Product Development Manager
EnviroGuard
Montclair, California 91763

Abstract
Changes in Battery room regulation with International Building Code (IBC), Fire Code (IFC and NFPA), OSHA and best practices with IEEE have left questions on how to maintain compliance and industry standards. VRLA Batteries have specific requirements for compliance with the building codes, fire codes, OSHA and may be subject to additional requirements from Authorities having Jurisdiction (AHJ). Learn the requirements for VRLA batteries and how to be compliant with current regulation. Also learn the various rack compliance requirements and best practices including IBC, UBC, NEBS, IEEE and more.

Introduction
Battery room compliance can be interpreted differently depending on your battery type, amount of cells or multi-cell units in a common area, volume of electrolyte and voltage present. Although the code is specific about requirements, the local interpretation can vary depending on the end users experience or awareness. Building Code, OSHA and fire code may have distinctive requirements for the same product which also causes another layer of confusion. In this paper, we will discuss the requirements that are most commonly misunderstood and the proper action plan.

A Simple Overview of the Code
Today, there are two main building codes and two main fire codes depending on your local and state adoption. However, it is important to note that there may be requirements of the local Authority Having Jurisdiction (AHJ) that require more than the minimum code requirement. New York City is a great example on how a local AHJ has modified the International Fire Code to meet the specific requirements of a city or metropolitan area. The B-29 that was enacted for all five boroughs requires facilities to install additional signage and train personnel who are required to carry an active certificate.

Figure 1 lists the codes related to Vented Lead Acid (VLA) and Valve Regulated Lead Acid (VRLA) Batteries. This paper will explain parts of the code specific to VRLA batteries.

A look at VRLA compliance

Over the years, VRLA batteries have been called sealed batteries and maintenance free batteries. They have been known over the years for the limited exposure to electrolyte and, in many cases, limited exposure to voltage by being in an enclosed cabinet. When considering compliance, there are advantages of VRLA batteries over VLA batteries. However, there are compliance items that do not distinguish between battery type.

	VLA/Flooded Batteries			VRLA Batteries		
Topic	**IFC**	**NFPA 1**	**OSHA**	**IFC**	**NFPA 1**	**OSHA**
Safety Caps	608.2.1	52.3.1.1		608.2.2	52.3.1.2	
Thermal Runaway Protection	608.3	Not Required		608.3	52.3.2	
Spill Control	608.5	52.3.4.1	1926.441(a)(4)	Not Required	Not Required	
Neutralization	608.5	52.3.5.2		608.5.2	52.3.5.2	
Ventilation	608.5.1	52.3.6	1926.441(a)(1)	608.6.1 608.6.2	52.3.6	
Signage	608.7	52.3.8		608.7	52.3.8	
Seismic Protection	608.8	52.3.9		608.8	52.3.9	
Smoke Detection	608.9	52.3.10		608.9	52.3.10	
Covers & Shields	-	-	-	-	-	
PPE	-	-	1926.441(a)(5)	-	-	1926.441(a)(5)
Eyewash/Shower	-	-	1926.441(a)(6)	-	-	1926.441(a)(6)
Shrouds & Shields	-	130.6(F)	29 CFR 1910.308 (a)(7)(IV) 29 CFR 1910.333(a) 29 CFR 1910.333(c)(5) 29 CFR 1910.335	-	-	

Figure 1 – Code Summary

Thermal Runaway Protection

IFC608.3; NFPA 52.3.2

Thermal runaway is a condition caused when the internal heat generation inside a battery exceeds the rate of heat dissipation. In VRLA batteries, higher charge currents have an increased oxygen generation at the positive plate and results in increase recombination at the negative plate that causes heat generation. If the VRLA battery is overcharged, venting will occur causing battery dry out and will continue to generate heat inside the battery. Other factors include: high room temperature, high charge current, inadequate ventilation, inappropriate battery spacing, ground faults, and battery shorts. Batteries should be maintained according to the manufacturer's maintenance schedule and IEEE-1188 best practices. Approved devices should be used to measure and trend parameters to avoid a thermal runaway condition.

Ventilation

IFC 608.6.1, 608.6.2; NFPA 52.3.6; IEEE 1635

The maximum concentration of hydrogen is not to exceed 1.0 percent of the total volume of the room or inside a cabinet (includes boost charging). Hydrogen monitors can be used to notify of improper ventilation or failure of a ventilation system. However, they need to be tested periodically and maintained to manufacturer's specification. Sensors can be exposed to trace contaminants, loose sensitivity over time and may need to be replaced periodically. Another acceptable ventilation method is to provide continuous ventilation at a rate of not less than 1 cubic foot per minute per square foot (1 ft3 /min/ft2) [0.0051 m3 /s · m2] of floor area of the room.

Spill Control and Neutralization

IFC 608.5; NFPA 1 52.3.5; IEEE-1188 4.2

IFC and NFPA1 codes require neutralization for VRLA batteries. IFC 608.5.2 states, "Recombinant battery neutralization. For VRLA or other types of sealed batteries with immobilized electrolyte, the method and material shall be capable of neutralizing a spill of 3 percent of the capacity of the largest VRLA cell or block in the room to a pH between 7.0 and 9.0." NFPA 52.3.5.2 states "For non-recombinant batteries and VRLA batteries, the method shall be capable of neutralizing a spill from the largest battery to a pH between 7.0 and 9.0." While VRLA batteries are exempt from spill control, they are not exempt from neutralization. The International Fire Code (IFC) and the National Fire Protection Agency (NFPA) both require neutralization. However, local Authorities Having Jurisdiction (AHJ) may require spill control in some areas.

Spill Kits

Many facilities use an emergency spill kit to satisfy the neutralization requirement of the fire code for both VLA and VRLA batteries. While this is an acceptable form of neutralization, the local OSHA authority will require training on the use of an emergency spill kit as it requires a person to clean up a hazardous spill as stated in 20 CFR 1910.120 App C paragraph "Occupational Safety and Health Standards". Training includes: Control measures and techniques, the safety plan for the company, employee's duties and function, Notification of appropriate persons, the need for personal protective equipment, decontamination procedures, preplanning activities for hazardous substance incidents, hands-on training with protective equipment, refresher training, and other requirements. The use of a spill kit is more than simply purchasing one and placing it in the corner of the battery room.

Passive Neutralization

The use of a passive neutralization method utilizes spill control systems and are mostly deployed for flooded batteries. While spill control systems can be used on VRLA batteries, it is largely considered overkill as there is not a requirement for spill control with VRLA batteries. However, the use of a spill control device or pan with a minimal amount of neutralizer will satisfy the code and eliminate the need for an emergency cleanup by site personnel. This method commonly uses a pan or tray with absorbing pads that contain neutralization compound. In addition, there are compounds on the market that are pH reactive which is an indicator that there is a spill of electrolyte rather than just water. These alternate methods provide a safer environment for the site and first responders to an incident.

To determine passive neutralization is feasible, an assessment of the equipment is necessary to check for a clear area to place a pan or tray. Since spill control is not required, a 4" barrier is not necessary and a tray with a lower profile may be used. The next few points describe applications where passive neutralization may be used.

- ***Open Racks:*** Open Racks with VRLA batteries present a challenge with the use of pans due to the stanchion placement. If passive neutralization methods are desired, a barrier, liner or epoxy covering and pads with minimal neutralizing compound may be used. Keep in mind that only 3% of the electrolyte in the largest cell or multi-cell unit needs to be neutralized, so a pillow designed for VLA applications will be more neutralization than required.

- ***Cabinets:*** In many configurations, a tray with absorbing and neutralizing pads is sufficient. However, the cabinet design must be considered. If the cabinet is designed with outer supports or casters, a short non-conductive pan can be used providing it doesn't impede airflow through a raised floor or bottom of the cabinet. If there are obstructions in the center of the cabinet, then a traditional control system, as described in the open rack section, may be used.

- ***Large VRLA (Modular):*** Many modular system racks are supported with a base beam on either side of the lowest module. With this design, the pan option is the best unless a center beam is present. Size the pan so that it provides protection at least two inches past the pressure relief valve. There are battery designs that contain a support structure in the front module, thus it will not be possible to use a pan in this application. Instead, a standard barrier is recommended with the pads that contain less neutralizing absorbing compound.

Signage

IFC 608.7; NPFA 52.3.8

Approved signs are required for Entrances to rooms and buildings with stationary battery systems of all technologies. Signs need to state the room has "energized battery systems, energized electrical circuits, the battery electrolyte solutions, where present are corrosive liquids." In addition, cabinets with VRLA batteries have a separate requirement to identify the details of the battery system, electrical, chemical and fire hazards. Remember New York City B-29 Certificate of Fitness requires a specialized sign kit for all five boroughs. Check the B-29 documentation at http://www.nyc.gov/fdny for more information.

Covers and Shields

NFPA 130.6(F); OSHA 29 CFR 1910.308; 29 CFR 1910.333; 29 CFR 1910.335

There are many regulations protecting people from energized parts. If batteries are not in a cabinet, covers or shields should be in place to protect employees and workers from dangerous voltage. Parts of the battery system that should be shrouded include terminal plates, inter-cell connectors and any other point in the system greater than 50 volts.

Seismic Protection

IBC 2012; IFC 608.8; NFPA 52.3.9, Telcordia GR-63 (NEBS)

With the adoption of IBC 2012 & IBC 2015 in many states, racks must meet the new seismic requirements stated in the building code.

The Uniform Building Code (UBC) was superseded by the International Building Code (IBC 2006, 2009 and 2012). The UBC utilizes a simple system of zones to identify seismic severity. IBC uses a four factor system to achieve an S_{DS} rating. S_{DS} is defined as the short ground shaking intensity which can be calculated by using the online tool at the http://earthquake.usgs.gov/designmaps.

The four factors are:

1. Site Class (soil factors: Hard bedrock or stiff soil)
2. Location in the building (at ground, below ground or above ground level)
3. Importance Level (essential or non-essential facility)
4. Short term acceleration - z/h factors (Spectral Response Acceleration Ground Motion Maps)

From these four factors, S_{DS} (design spectral acceleration at short periods) is the value called out in battery rack specifications that meet IBC 2012. In order to meet IBC 2012, the battery rack needs to have an established SDS Level for different site classes and z/h factors, stamped drawings by a PE identifying racks as IBC 2012 certified and a certification letter(s) identifying IBC Certification and S_{DS} Levels. It is important to understand that to achieve IBC 2012 certification for “Essential Facilities”, triaxial shake testing is required rather than just finite element analysis (FEA). In addition to IBC, many telecommunications companies use Telcordia Technologies GR-63-CORE Network Equipment Building Systems (NEBS) standard which requires an additional shake table test. GR-63 requires that in the event of an earthquake, “The equipment shall sustain operation without replacement of components, manual rebooting and human intervention.” In other words, a rack or enclosure must provide a level of protection which the network remains active during an earthquake. Please note that NEBS certification does not necessarily equate to IBC certification.

Summary

While VRLA batteries do not have exposed electrolyte under normal conditions, there are regulations that are specific to VRLA batteries and also regulations that are inclusive of both VLA and VRLA batteries. VRLA batteries have the potential for exposure to electrolyte, dangerous voltage, overheating, and outgassing. Codes must be understood to properly maintain compliance of areas and rooms containing standby power systems to protect employees and your company. New seismic parameters have been updated in the Building codes to not only account for the location of the battery system, but also the soil factors, location in the building (elevation) and even the site importance. As codes tend to be updated every 2-3 years, it is important to know the codes affected in your area, communicate with your AHJ to understand local requirements and understand training requirements based on your compliance methods.

References

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