MISSION CRITICAL FACILITIES DESIGN
UPS BATTERY ROOM ENVIRONMENT
CRITICAL DESIGN CONSIDERATIONS

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INTRODUCTION

It can be very effectively argued that the *heart* of any UPS system supporting a mission critical facility is the battery plant. Examples of mission critical facilities include large corporate data centers, Web hosting facilities, and telecom carrier hotels.

When commercial power is interrupted in mission critical facilities, businesses are placed at significant risk to lose revenues, clients, and/or corporate image. The emergency power systems, which the UPS battery plant is a significant piece of, must perform up to expectations and support the facility through any and all power outages.

This paper will highlight those environmental design features that must be taken into consideration when designing, constructing, and fitting out a UPS battery room that will result in more than just a physical room to house the strings of batteries.

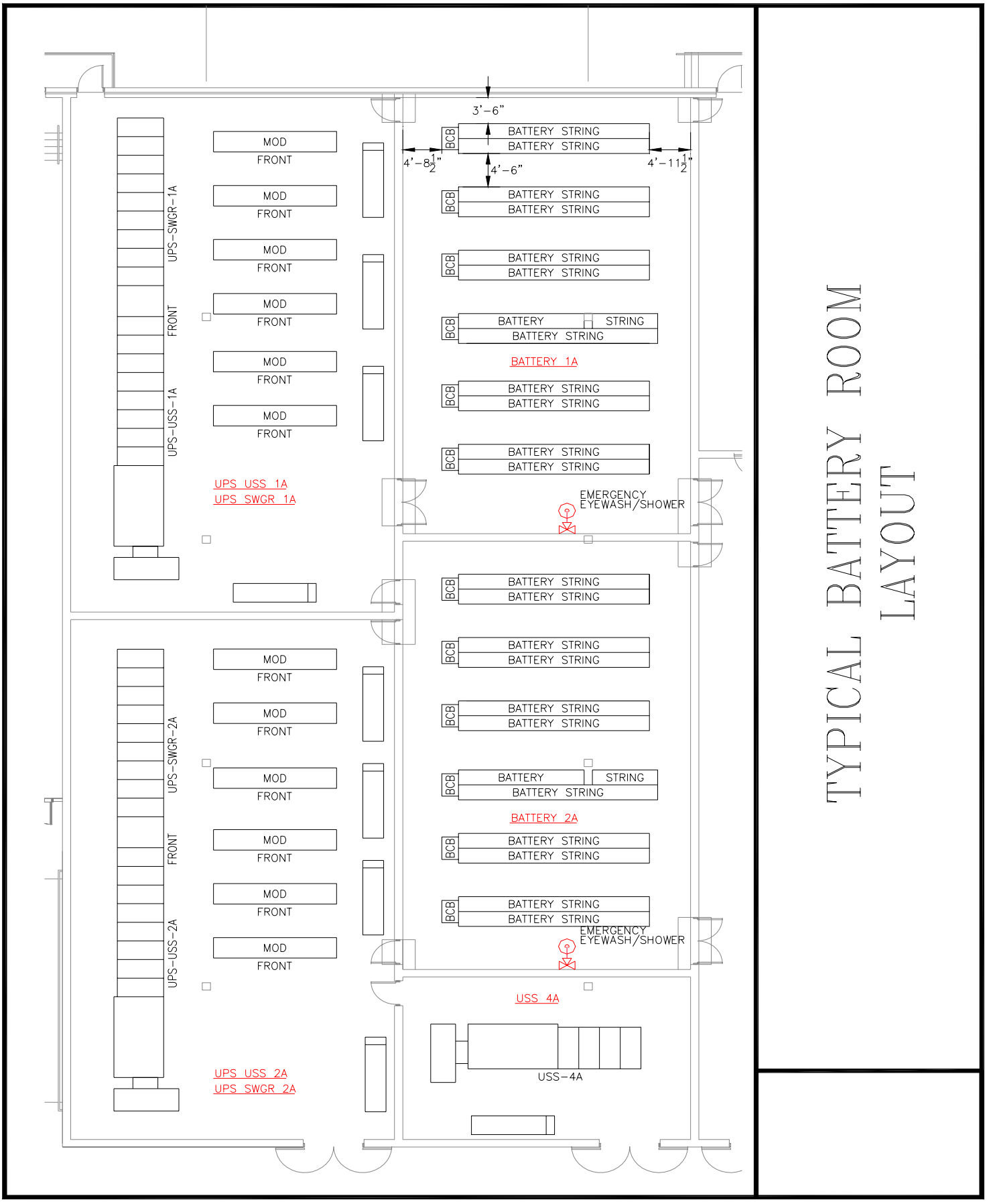
Properly designed and constructed battery rooms in mission critical facilities will provide a safe, efficient, environmentally friendly place to house and care for critical UPS battery systems, enabling them to provide optimum performance when needed.

BATTERY ROOM DESIGN CRITERIA

Battery Room Positioning and Layout

The positioning of the battery room must be in close proximity to the UPS modules being supported. For voltage drop considerations, the UPS modules and battery systems should be in adjacent spaces— either side-by-side or vertically stacked.

Battery room layouts should be clean and designed to maximize space usage. Proper code clearances must be maintained in and around battery strings for required maintenance support and life safety systems. Egress aisles, exit ways, and maintenance aisles also must be maintained. NEC, NFPA Life Safety Code, BOCA and local codes must be taken into consideration and complied with when appropriate. The attached drawing is an example of a large multi-module UPS battery room layout.


TYPICAL BATTERY ROOM LAYOUT
3'-6"
4'-8 1/2"
4'-6"
4'-11 1/2"
BCB
BATTERY STRING
BATTERY
STRING
MOD
FRONT
UPS-SWGR-1A
UPS-USS-1A
UPS-SWGR-2A
UPS-USS-2A
BATTERY 1A
BATTERY 2A
UPS USS 1A
UPS SWGR 1A
UPS USS 2A
UPS SWGR 2A
EMERGENCY
EYEWASH/SHOWER
USS 4A
USS-4A

Battery Rack/Cabinet Issues

Battery racks and cabinets should be designed and installed to meet the requirements for the seismic zone they are installed in. The racks and cabinets should be designed and purchased to accommodate the weight and size of the batteries ordered and the quantity of batteries to be installed. (See attached picture.)

Where space constraints permit, flooded wet cell batteries should be installed in a two tiered racking configuration to make maintenance activities easier and safer to perform. A uniform average cell temperature also is somewhat easier to obtain with a two-tiered configuration instead of a three-tiered configuration.

Building Structural Issues

Due to the weight of lead acid batteries, column and floor loading can quickly become a problem. Flooded wet cell batteries racked two or three tiers high in a limited floor area can easily impress a 250 – 450 lbs./SF floor loading on the structural floor and which transfers to columns and footers.

Although this issue arises in new construction and existing renovation and reuse projects, the greater challenges occur in the renovation projects.

While extensive, expensive reinforcing of structural elements is usually required to accommodate heavy battery loading in renovation projects, building floor slabs, columns, and footers in new construction can be much more easily designed and constructed.

Figure 1. Battery Rack And Structural Issues

Fire Compartmentalization Issues

In a properly designed facility, battery rooms will be isolated from each other, other equipment areas (UPS modules, electrical switchgear, etc.) and people spaces by a two hour fire rated wall. Additionally, where space constraints permit and there are multiple, multi-module UPS systems serving the facility's computer loads, individual UPS

battery support systems should be located in separate, fire compartmentalized rooms. This design strategy would also apply to the large multi-module UPS systems themselves.

The principle is one of containment and isolation of a catastrophic failure on one system from affecting other systems and occupancies in the facility. A failure on one battery system supporting UPS "A" will not also disrupt power to UPS "B." This is particularly important in facilities where completely separate and independent dual power path systems supporting dual power cord IT equipment is the objective.

Fire Detection/Suppression Systems

Individual battery rooms should be treated as separate zones for fire detection and suppression purposes. Each room should have a digitally addressable, early warning fire detection system installed and connected into the central fire detection system. Additionally, a pre-action sprinkler system should be installed to suppress any battery fire within the room, should one occur. This system should be tied into the central fire monitoring system for the facility.

Care should be taken in the design and installation of these systems to assure that they meet all applicable federal, state, and local fire and life safety codes.

Grounding Issues

All battery racks and cabinets associated with UPS systems should have NEC code green wire grounds linking all racks, for safety reasons. Periodic inspections should be made of the grounding system to assure that continuity is maintained.

Battery Room EPO Systems

Battery rooms should be equipped with a centralized Emergency Power Off (EPO) system that can disconnect power in the room from the UPS common battery buss or individual UPS module(s) being supported by this room. This EPO system enables the facility management team to quickly isolate a battery system experiencing problems and thereby mitigate a potentially dangerous situation.

An EPO device should be located at all egress points from the room and be tied into the central alarm system and monitored.

Figure 2. Emergency Power Off (EPO) Device

Battery Remote Monitoring Alarm Systems

All battery systems should be equipped with an individual cell monitoring system to alert owners to the condition of their batteries serving mission critical IT equipment. Without an adequate cell monitoring system, individual battery cells' problems can be masked until they are actually called upon during utility power failures. These systems provide continuous battery performance data for short and long duration outages. Additionally, these systems can be remotely alarmed to alert operations personnel when UPS systems transfer to battery. Remote alarming allows for timely response to investigate potential UPS or battery problems.

Temperature Control Considerations

For optimal battery performance, battery room HVAC systems should be designed to maintain a uniform average ambient room temperature of 77° F. Battery room temperatures below 77° F increase battery life but degrade battery performance during periods of heavy discharge. However, battery room temperatures above 77° F increase battery performance but degrade battery life.

In situations where battery rooms border outside walls and unconditioned spaces, wall and ceiling surfaces should be insulated to help achieve the uniform ambient room temperature objective.

Hydrogen Gas Detection and Ventilation Systems

Battery rooms should be designed with an adequate exhaust system, which provides for continuous ventilation of the battery room to prohibit the build up of potentially explosive hydrogen gas. During normal operations, off gassing of the batteries is relatively small. However, the concern is elevated during times of heavy recharge of the batteries, which occurs immediately following a rapid and deep discharge of the battery plant.

A secondary and larger volume fan is usually installed and connected to the hydrogen detection system, which senses a gas build up, causing the secondary fan to activate. The secondary fan also is automated to sense the failure of the smaller fan, in which case the larger fan would activate.

These systems should be installed with remote alarming capability, to report a hydrogen gas build up and abnormal operating conditions.

Figure 3. Spill Containment/Cleanup Kit

Battery Room Lighting and Miscellaneous Power Designs

The battery room light fixtures should be designed and installed to properly coordinate with the battery racking for maximum usable illumination of lower tier racks. This usually means installing fixtures over the maintenance aisles. An objective to shoot for would be 50 to 60 foot-candles at the maintenance task level. In many cases, supplemental portable lighting systems will be used to achieve adequate light levels in all areas of the battery room. Miscellaneous power receptacles (wall receptacles) should be strategically and liberally placed throughout the room for ease of use of power tools, portable battery chargers, and other battery maintenance equipment.

Environmental Spill Containment

Code required spill containment must be provided to adequately contain potential acid spills from cracked or otherwise leaking flooded wet cell batteries. Localized under-rack containment systems can be utilized or a whole room containment concept can

be employed by adequately curbing the entire perimeter of the battery room. Adequate quantities of absorbent materials and acid neutralizing agent should be maintained in the room for use in spill containment and clean up operations.

Additionally, battery room floors should be sealed and all floor drains that exist within the battery room or otherwise in proximity to flooded wet cell batteries should be capped, sealed or curbed to prevent spilled acid from reaching storm or sanitary drainage systems.

Figure 4. Eye Wash / Shower Station in Background

Eye Wash/Deluge Shower Station

Every battery room should have a combination eye wash/deluge shower station to provide a means of decontaminating personnel exposed to and contaminated by battery acid. These systems should be located in close proximity to the battery systems but separated from them by the proper code clearances.

Each battery eye wash/shower system should be remotely alarmed and monitored to identify and annunciate any indication of water flow. Water flow in one of these systems could mean that someone is in need of help, and personnel could and should be dispatched to investigate and render assistance as required.

Summary

As noted above, there are many critical design elements and issues to be taken into consideration when planning, designing, and constructing a mission critical UPS battery room. Additionally, there are numerous relevant federal, state, and local code issues that must be addressed in the design.

The above discussion topics are not necessarily an all-inclusive list of topics to be considered at all locations. However, it is a good overview of most of the universally relevant items that need to be addressed to be successful in providing a modern, safe, efficient, and updated battery room environment.

At the "end of the day," local operations personnel **must** be able to meet ongoing battery maintenance and monitoring needs, and the site management team **must** have confidence that the battery systems will perform **as expected, when needed**!