WARNING

BATTERIES ARE POTENTIALLY DANGEROUS AND PROPER PRECAUTIONS MUST BE OBSERVED IN HANDLING AND MAINTENANCE.

WORK ON BATTERIES SHALL BE PERFORMED ONLY WITH PROPER TOOLS AND SHALL UTILIZE THE PROTECTIVE EQUIPMENT LISTED.

BATTERY MAINTENANCE SHALL BE DONE, BY PERSONNEL KNOWLEDGEABLE OF BATTERIES AND TRAINED IN THE SAFETY PRECAUTIONS INVOLVED.

14.1 DESCRIPTION

This chapter covers stationary rechargeable storage battery[1] banks and the Safety Requirements related to the installation, maintenance, testing, and replacement of station batteries, DC power supplies, mission critical stand-by power supplies, and uninterruptible power supplies (UPS).

14.2 TYPES OF HAZARDS

Working with batteries can expose a worker to chemical, shock and/or arcing hazards. Although a person's body might react to contact with DC voltage differently than from contact with AC voltage, NFPA 70E and OSHA take a conservative position and consider the risk of shock or electrocution to be the same for both AC and DC exposures greater than 50 volts.

In addition to the electrical hazards (shock and arcing), batteries also expose a worker to chemical hazards associated with the electrolyte used in the battery. Electrolytes are highly corrosive and can produce severe burns on contact.

Employees must understand that batteries being charged will generate hydrogen gas. For this reason, work performed on an in-service battery system shall use methods or tools that preclude circuit interruption or arcing in the vicinity of the battery.

When selecting work practices and personal protective equipment, employees shall consider exposure to these hazards to prevent accidental short-circuit that can result in electrical arcing, explosion, and/or "thermal runaway" of the batteries.

[1] NFPA 70E Art.320.2 definition: An electrochemical system capable of storing under chemical form the electric energy received and which can give it back by reconversion.

Scheduled inspection and maintenance should verify and maintain the proper wiring configurations and proper charging rates as per manufacturer's instructions.

14.3 CODES AND STANDARDS - SAFE WORK PRACTICES

The following codes and standards shall be followed when working with batteries:

NEC, Article 480 – titled: Storage Batteries
NFPA 70E, Article 320 – titled: Safety Requirements Related to Batteries and Battery Rooms
NESC, Section 14 – titled: Storage Batteries
OSHA 29CFR1926.403 – Electrical Subpart K, General Requirements
IEEE Std. 450 titled: Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications
IEEE Std. 484 titled: Recommended Practice for Installation Design and Installation of Vented Lead-Acid Batteries for Stationary Applications
IEEE Std. 1187 titled: Recommended Practice for Installation Design and Installation of Valve-Regulated Lead-Acid Storage Batteries for Stationary Applications
IEEE Std. 1188 titled: Recommended Practice for Maintenance, Testing, and Replacement of Valve-Regulated Lead-Acid (VRLA) Batteries for Stationary Applications

Batteries are a source of stored energy and it is not possible to isolate the voltage source of a cell. Though, in large battery banks it is possible to limit the number of cells that are connected together.

Where the battery section exceeds 120 volts the installation shall include an isolating switch, plugs or links, as required, to isolate sections of the battery, or part of the battery for maintenance.[2] This decreases the available voltage capacity and arcing hazard.

Battery connections shall be maintained clean and tight to prevent excessive heating due to contact resistance.

Battery connections shall never be disconnected when current is flowing, since a hazardous arc can occur.

14.4 SAFETY REQUIREMENTS

Installation, maintenance, testing and replacement of a battery or batteries shall require a written procedure, job hazard analysis (JHA), and a pre-job safety briefing that includes the manufacturer's instructions before work can commence. Relevant training requirements must be current for work participants.

14.4.1 "VALVE-REGULATED" LEAD ACID BATTERY BANKS

"VALVE-REGULATED" LEAD ACID (VRLA) batteries have sealed cells and are protected by an internal relief valve that opens to the atmosphere when the internal gas pressure exceeds a pre-selected amount.

[2] NFPA 70E Article 320.7(E) – Section Isolating Equipment

Although VRLA cells can vent or leak small amounts of electrolyte, electrical safety is the principal concern, and safe handling shall also be a consideration. The following equipment to protect personnel from electrical hazards and safe handling of the batteries shall be available:

(a) Safety glasses with side shields, or goggles, or face shields, as appropriate
(b) Acid resistant gloves or gloves appropriate for the installation (see "Safety Notes", below)
(c) Protective aprons and safety shoes
(d) Portable or stationary water facilities in the battery vicinity for rinsing eyes and skin in case of contact with acid electrolyte
(e) Class C fire extinguisher
(f) Acid neutralizing agent (see "Safety Notes", below)
(g) Adequately insulated tools
(h) Lifting devices of adequate capacity, when required

14.4.2 "VENTED" LEAD ACID BATTERY BANKS

A "VENTED" LEAD ACID battery contains a liquid acid electrolyte in which the products of electrolysis and evaporation are allowed to escape freely to the atmosphere. Because "VENTED" LEAD ACID batteries contain liquid electrolyte, chemical safety is the principal concern; electrical safety and safe handling shall also be considerations. Specific chemical concerns are electrolyte spillage and the potential for buildup of hydrogen gas creating an explosion hazard. The following equipment to protect personnel from chemical hazard, electrical and safe handling of the battery, shall be available:

(a) Splash Goggles and face shields
(b) Acid-resistant gloves
(c) Protective aprons and safety shoes
(d) Portable or stationary water facilities for rinsing eyes and skin in case of contact with electrolyte
(e) Acid neutralizing agent (see "Safety Notes", below)
(f) Class C fire extinguisher
(g) Adequately insulated tools
(h) Lifting devices of adequate capacity, when required

SAFETY NOTES for Sections 14.4.1 and 14.4.2 (above):

1. Appropriate gloves for VRLA batteries are defined as gloves that protect the worker from the perceived worst-case hazard that the worker may experience during an activity. The worst-case hazard may vary on a job based upon the job sequence. For example, the worst-case hazard for battery handling into or out of position is likely physical damage or chemical spillage, whereas, the battery interconnection wiring hazards may be electrical due to arcing, shock or short-circuit. Glove selection should consider the worker's task(s) and manual dexterity requirements.
2. Some battery manufacturers do not recommend the use of CO_2 fire extinguishers due to the potential of thermal shock.

3. Although VRLA cells are designed to minimize electrolyte leakage, neutralize any electrolyte that has leaked from either VLRA or vented batteries with approved appropriate neutralizing agents.
4. The removal of neutralization material from an acid spill will result in production of hazardous waste. The user shall contact the Materiel and Environmental Services (M&ES) Division for support and assistance to comply with appropriate governmental regulations.
5. Barriers to prevent the spread of acid spills are extremely important when moving cells, such as during battery installation or removal activities.

14.5 LABELING AND WARNING SIGNS

MARKING – when the battery capacity exceeds 100 amp-hours or the nominal battery voltage is greater than 50 volts, suitable warning notices indicating the battery voltage and prospective short-circuit current of the installation shall be displayed.[3]

WARNING SIGNS – shall be posted in appropriate locations.

- Electrical hazard – indicating shock hazard due to battery voltage and the arcing hazard due to the short-circuit current.
- Chemical hazard – indicating the danger of hydrogen explosion and chemical burns from the electrolyte.
- Notice for personnel to use and wear protective equipment and apparel.
- Notice prohibiting access to unauthorized personnel.

INFORMATIVE SIGNS – shall be posted on or adjacent to the battery bank.

- Total DC voltage available.
- Total short-circuit current available.

14.6 TOOLS

Tools used for working on batteries shall be:

- designed for the task and sized and/or insulated to prevent incidental contact between battery terminals eliminating the potential for arcing and ignition of flammable mixtures, such as vented hydrogen gas in air.
- listed, insulated, and rated for the voltage being worked on.

14.7 STORAGE AND STAGING OF BATTERIES

During storage and staging, terminals should be covered with an insulating material to prevent accidental shorting of the battery posts. Insulating materials shall be electrically non-conductive and may consist of cardboard, plastic or shipping materials used by the manufacturer of the replacement batteries. Containment and acid spill clean-up materials should be available for use in the event of a spill.

[3] NFPA 70E Article 320.7(A)(1) - Marking