EAGLE EYE
WHITE PAPER

Title	**Industry White Paper**
Document No.	**WP-042522-1**

Revision History

Date	Revision	Change Description	Author(s)
4/25/22	0	Original document	JAB

Some Codes and Standards Applicable to Stationary Batteries and their Chargers.

***"The great thing about codes and standards is that there are so many to choose from."* - Anon.**

Introduction.

There are multiple organizations and entities that publish codes, standards, guides, and practices pertaining to the storage, transportation, installation, maintenance, testing, and disposal of stationary lead-acid batteries and their chargers. Almost all of these are updated and revised on a regular basis. There is an inherent problem in these revision cycles in that almost all the various documents are out of sync and consequently may cause some conflict. Also, there is confusion within the industry as to which documents might apply, what is mandatory and what is not, and what is the latest issue or revision.

Codes, Standards, Guides, and Practices. What Gives?

The manufacture, transportation installation, operation, maintenance, and disposal of stationary batteries are governed by a myriad of Codes, Standards, Guides, and Practices. It can really be a confusing maze leading to a potential minefield. For example, the base code is typically the applicable electric code such as the National Electrical Code (NEC) or the Canadian Electrical Code (CEC) in North America or the International Electrotechnical Commission (IEC) in Europe. However, there are countries with no national code of their own. In these cases, electrical safety may be governed by a specific electrical code of another country, or the operating company may accept the safety rules and practices of the country where the equipment is built or where the installation crew is based. The same rationale may apply to practices governing installation, operation, and maintenance of the standby power equipment. So, what are the basic differences between the terms Codes, Standards, Guides, and Practices? Because of the breadth of the governing documents pertaining to stationary batteries, this paper concentrates mainly of those that are applicable in North America.

Codes.

Codes are developed and promulgated at national, state, or local levels and are enforced by law. Model Codes are codes created by national organizations and include such things as fire codes, building codes, electrical codes, etc. Many local Authorities Having Jurisdiction (AHJ's), such as cities, counties, states, etc., can choose to adopt a model code but it may not be the most current edition of a code and could lag by several years. AHJ's often modify existing codes, or indeed, write their own version of a particular code. A good example of a model code setting body in the United States is the National Fire Protection Association (NFPA) which publishes several codes, including the National Electrical Code (NEC) NFPA 70 and the Standard for Electrical Safety in the Workspace, NFPA 70E®. The largest model code bodies in the United States are the NFPA and the International Codes Council (ICC). The ICC promulgates a large number of codes, but of special interest to batteries and chargers are the International Building Code (IBC) and the International Fire Code (IFC). For codes, the wording "must" and "shall" is generally used.

Standards.

Unlike codes, standards are not enforceable by law. They are usually consensus documents developed by interested bodies so that a "standard" approach can be taken with respect to the design, operation, maintenance, etc. of similar products. Although not enforceable by law, standards can play a huge part in how manufacturers and end users determine how a product is made and used. Non-compliance can be detrimental. The word "shall" is used frequently in standards. The American National Standards Institute (ANSI) issues both codes and standards. In many cases, not complying with a standard can be detrimental to a violator in litigation cases.

Guides.

A guide is exactly what the name implies. It is a document that "guides" the user through a process or action. Most of the IEEE-battery-related documents are guides. They have no force of law. The wording is usually "should" or "may."

Practices.

Practices are generally methods, procedures, processes, and rules used to fulfill a particular requirement. Best practices are methods and techniques that have proven results and can be used as benchmarks to strive for. Rather than "shall," the wording is generally "should."

Codes and Standards Adoption.

Sometimes the codes/standards of one issuing body are adopted by other codes/standards bodies. For example, an IEEE standard may be adopted by the American National Standards Institute and this document would then be published as an ANSI/IEEE Standard.

Codes and Standards Enforcement.

Many codes and standards compliance officials, such as building and electric inspectors and fire marshals, are not familiar with batteries and the interpretation of battery codes/standards. Indeed, the same can be true for specification writers who often request adherence to certain codes and standards without fully understanding the requirements or implications in using various documents that affect batteries and chargers. It is not possible to detail them all. It is also recognized that many countries and regions issue their own documents that cover stationary batteries, and to cover them all is outside the bounds of this paper; consequently the focus is on North American and European sources.

The Institute of Electrical and Electronics Engineers (IEEE).
The IEEE has several technology or industry specific groups of subject matter experts called Societies, one of which is the Power and Energy Society (PES). Under the auspices of the IEEE PES are several committees, one of which is the Energy Storage and Stationary Battery committee (ESSB). The IEEE PES ESSB writes codes and standards for batteries used in stationary (fixed) use such as Telecommunications, UPS and Utility applications. These are written and approved by "Working Groups" which are comprised of IEEE members that have knowledge of, or interest in, a specific document. Since those in these working groups usually represent all segments of the industry, such as manufactures, integrators, maintainers and end users, the documents produced are usually "consensus" documents. All of these documents are subject to a five-year review process which in turn can take up to five years. Some of the more significant of these documents are listed in the bibliography.

The National Fire Protection Association (NFPA)

The NFPA is an international not-for-profit organization, and its main function is to write building safety standards. The main focus of the NFPA is fire protection, but it also concentrates on other building and environmental hazards. The NFPA has a presence in over 100 countries. Its codes, where adopted, have the force of law. Sometimes, the NEC codes are in conflict with the IEEE, although a lot of work has been put in by both groups to try and harmonize the NFPA with the IEEE and also to correct erroneous or misleading information within the NFPA. Some significant NFPS codes are:

- The National Electric Code (NEC) NFPA 70. This code addresses safety in the installation and maintenance of electrical devices. Article 480 is titled Storage Batteries and applies to all storage and stationary battery installations. There is some new and revised information effecting battery installations. Recently, some of the battery information in Article 706 of the NEC has been moved to Article 480. Associated with NFPA 70 are:
- NFPA 70E. *Standard for Electrical Safety in the Workplace*. Covers employee safety during activities such as the installation, operation, maintenance, removal of electrical equipment. Article 240 covers batteries and battery rooms. Article 320 deals with the installation of stationary batteries and contains a lot of information regarding AC Arc Flash but DC Arc Flash is lacking.
- NFPA 70B. *Recommended Practice for Electrical Equipment Maintenance.* This details preventative maintenance for electrical, electronic, and communications systems and equipment used in industrial plants, institutions, and commercial buildings in order to prevent equipment failures and worker injuries.
- NFPA 1. *Fire Code*. This code was formerly called the Fire Prevention Code but when the Uniform Fire Code (UFC) and the Uniform Fire Code Association joined with the NFPA, this new fire code was written. There is a lot of content regarding batteries, especially spill containment

Some Industry Specific Codes and Standards.

The Alliance for Telecommunications Industry Solutions (ATIS).

ATIS's Sustainability in Telecom: Energy and Protection (STEP) Committee develops and recommends standards and technical reports relating to the electrical protection of telecommunications networks and power systems and power system interfaces with telecommunications load equipment. These include:

- ATIS-0600003, *Battery Enclosure and Room/Areas.*
- ATIS-0600313, *Electrical Protection for Telecommunications Central Offices and Similar Type Facilities.*
- ATIS-0600316, *Electrical Protection for Telecommunications Outside Plant.*
- ATIS-0600333, *Grounding and Bonding of Telecommunications Equipment.*

FERC and NERC

The Federal Energy Regulatory Commission (FERC) is an independent agency within the U.S. Department of Energy which regulates the interstate transmission of electricity and natural gas. FERC oversees the

North American Electric Reliability Corporation (NERC) whose mission is to assure the effective and efficient reduction of risks to the reliability and security of the electrical grid. Of specific interest to batteries and chargers is the NERC Standard PRC-005 *Protection System Maintenance* whose purpose is to document and implement programs for the maintenance of all Protection Systems affecting the reliability of the Bulk Electric System (BES) so that the Protection Systems are kept in working order. Several parts of PRC-005 relate to batteries and chargers and are mandatory to the entities that fall under the jurisdiction of FERC.

IT and Data Centers.

The standards used for data center batteries are derived from the IEEE, for example IEEE 1184. *IEEE Guide for Batteries for Uninterruptible Power Systems,* and the International Electrotechnical Commission (IEC). In Europe, IEC has been the preferred standard, but U.S. operators are beginning to adopt IEC standards as more and more operate data centers around the world.

The IEC

The IEC authors international standards for all electrical, electronic, and related technologies, including batteries. Most of the battery standards are focused on primary, motive power and Starting, Lighting and Ignition (SLI) batteries; but of interest to stationary batteries are:

- IEC 60086-2. *Batteries, General.*
- IEC/TR 6143. *Monitoring of lead-acid stationary batteries. Users Guide.*
- IEC Document 21/487/CD. *Stationary Lead-Acid Batteries. General Requirements and Method of Test. Part 1, Vented Types.*
- IEC 60896-1. *Stationary Battery Tests.*
- IEC /TR 62060. *Secondary Cells and Batteries – Monitoring of Lead-Acid Stationary Batteries – Users Guide.*

What about OSHA?

The Occupational Safety and Health Administration (OSHA) is the regulatory arm of the United States Department of Labor, whose mission is to assure safe and healthy working conditions. OSHA does not write standards but can levy fines and penalties for noncompliance with existing standards. OSHA can also request standards to be written in order to promote its mission. A good example of this is *NFPA 70E, Standard for Electrical Safety in the Workplace* and its companion document *IEEE 1584, Guide for Performing Arc Flash Calculations.*

Other codes of interest are:

The International Codes Council. Publishes the International Building Code and the International Fire Code among others. These codes have been adopted by all 50 states and contain information regarding standby power systems.

- The International Fire Code (IFC). This contains regulations to safeguard life and property from fires and explosion hazards. This includes the storage and use of hazardous materials.
- The International Building Code (IBC) sets requirements for structures and ancillary systems, including standby power systems. Of special interest, it addresses seismic design requirements for standby power systems. For example, a standby power system, including batteries, must be

certified to comply with the same seismic design requirements for the location in which it is installed, in accordance with the U.S. Geologic Survey data for seismic zones.

- Note. The Uniform Building Code (UBC). Some jurisdictions still mention this but like the Building Officials (BOCA) National Building Code and the Southern Building Code Congress International (SBCCI) Standard Building Code they have been replaced by the International Codes Council (ICC) standards in an effort to provide consistent standards throughout the United States.

How are the Building Codes enforced?
Adopting the latest building code is only part of the process. Codes must be effectively enforced to ensure that buildings and their occupants benefit from advances in seismic provisions in the model codes. For the most part, code enforcement is the responsibility of local government building officials who review design plans, inspect construction work, and issue building and occupancy permits.

The Federal Emergency Management Agency (FEMA) issues a document FEMA-1019 *Emergency Power Systems for Critical Facilities: A Best Practice Approach to Improving Reliability.*

The IEEE 3000 Standards Collection.
This is a family of industrial and commercial power systems standards formerly known as the IEEE Color Books. The term Color Books is derived from the color of the cover of the various books. Of particular interest to standby power systems are:

- IEEE 3003.2 IEEE Recommended Practice for Equipment Grounding and Bonding in Industrial and Commercial Power Systems.
- IEEE 3005.4 IEEE Recommended Practice for Design and Operational Considerations for Improving the Reliability of Emergency and Stand-By Power Systems.

Some Code and Standards issuing bodies that mention stationary batteries are shown below.

ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigeration, and Air-conditioning Engineers
ASME	American Society of Mechanical Engineers
ATIS	Alliance for Telecommunications Industry Solutions
BCI	Battery Council International
BOCA	Building Officials and Code Administrators. Superseded by the ICC
IBC	International Building Code
ICBO	International Conference of Building Officials. Superseded by the ICC
ICC	International Code Council
IEEE	Institute of Electrical and Electronics Engineers
IEEE/PAR	Project Authorization Request (a draft IEEE standard; denoted by a "P" preceding the document number)
IFC	International Fire Code

IBC	International Building Code
NEC	National Electrical Code
NFPA	National Fire Protection Association
NRC	Nuclear Regulatory Commission
SBCCI	Southern Building Code Council International. Superseded by the IBC.
UBC	Uniform Building Code. Superseded by the IBC.
UFC	Uniform Fire Code. Superseded by the IBC.
WFCA	Western Fire Chiefs Association. Superseded by the IBC.

Bibliography of Significant IEEE battery related documents.

Number	**Subject.**
IEEE 450.	*IEEE Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications.*
IEEE 484	*IEEE Recommended Practice for Installation Design and Installation of Vented Lead-Acid Batteries for Stationary Applications.*
IEEE 485	*IEEE Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications.*
IEEE 946	*IEEE Recommended Practice for the Design of DC Power Systems for Stationary Applications.*
IEEE 1106	*IEEE Recommended Practice for Installation, Maintenance, Testing and Replacement of Vented Nickel Cadmium Batteries for Stationary Applications.*
IEEE 1184	*IEEE Guide for Batteries for Uninterruptible Power Systems.*
IEEE 1187	*IEEE Recommended Practice for Installation Design and Installation of Valve-Regulated Lead-Acid Batteries for Stationary Applications.*
IEEE 1188	*IEEE Recommended Practice for Maintenance, Testing, and Replacement of Valve-Regulated Lead-Acid Batteries for Stationary Applications.*
IEEE 1189	*IEEE Guide for the Selection of Batteries for Standby Applications.*
IEEE 1491	*IEEE Guide for Selection and Use of Battery Monitoring Equipment in Stationary Applications.*
IEEE 1578	*IEEE Recommended Practice for Stationary Battery Electrolyte Spill Containment and Management*.
IEEE 1635	*IEEE/ASRAE Guide for the Ventilation and Thermal Management of Batteries for Stationary Applications.*
IEEE 1657	*IEEE Recommended Practice for Personnel Qualifications for Installation and Maintenance of Stationary Batteries.*
IEEE 1881	*IEEE Standard Glossary of Stationary Battery Terminology.*