2012 Fall Revision Cycle

Report on Proposals

A compilation of NFPA® Technical Committee Reports on Proposals for public review and comment

Public Comment Deadline: March 2, 2012

NOTE: The proposed NFPA documents addressed in this Report on Proposals (ROP) and in a follow-up Report on Comments (ROC) will only be presented for action at the NFPA June 2013 Association Technical Meeting to be held June 10–13, 2013, at the McCormick Place Convention Center, Chicago, IL, when proper Amending Motions have been submitted to the NFPA by the deadline of October 5, 2012. Documents that receive no motions will not be presented at the meeting and instead will be forwarded directly to the Standards Council for action on issuance. For more information on the rules and for up-to-date information on schedules and deadlines for processing NFPA documents, check the NFPA website (www.nfpa.org) or contact NFPA Standards Administration.

NFPA®
National Fire Protection Association®
1 BATTERYMARCH PARK, QUINCY, MA 02169-7471

ISSN 1079-5332

Information on NFPA Codes and Standards Development

I. Applicable Regulations. The primary rules governing the processing of NFPA documents (codes, standards, recommended practices, and guides) are the NFPA *Regulations Governing Committee Projects (Regs)*. Other applicable rules include NFPA *Bylaws*, NFPA *Technical Meeting Convention Rules*, NFPA *Guide for the Conduct of Participants in the NFPA Standards Development Process*, and the NFPA *Regulations Governing Petitions to the Board of Directors from Decisions of the Standards Council*. Most of these rules and regulations are contained in the *NFPA Directory*. For copies of the *Directory*, contact Codes and Standards Administration at NFPA Headquarters; all these documents are also available on the NFPA website at "www.nfpa.org."

The following is general information on the NFPA process. All participants, however, should refer to the actual rules and regulations for a full understanding of this process and for the criteria that govern participation.

II. Technical Committee Report. The Technical Committee Report is defined as "the Report of the Technical Committee and Technical Correlating Committee (if any) on a document. A Technical Committee Report consists of the Report on Proposals (ROP), as modified by the Report on Comments (ROC), published by the Association."

III. Step 1: Report on Proposals (ROP). The ROP is defined as "a report to the Association on the actions taken by Technical Committees and/or Technical Correlating Committees, accompanied by a ballot statement and one or more proposals on text for a new document or to amend an existing document." Any objection to an action in the ROP must be raised through the filing of an appropriate Comment for consideration in the ROC or the objection will be considered resolved.

IV. Step 2: Report on Comments (ROC). The ROC is defined as "a report to the Association on the actions taken by Technical Committees and/or Technical Correlating Committees accompanied by a ballot statement and one or more comments resulting from public review of the Report on Proposals (ROP)." The ROP and the ROC together constitute the Technical Committee Report. Any outstanding objection following the ROC must be raised through an appropriate Amending Motion at the Association Technical Meeting or the objection will be considered resolved.

V. Step 3a: Action at Association Technical Meeting. Following the publication of the ROC, there is a period during which those wishing to make proper Amending Motions on the Technical Committee Reports must signal their intention by submitting a Notice of Intent to Make a Motion. Documents that receive notice of proper Amending Motions (Certified Amending Motions) will be presented for action at the annual June Association Technical Meeting. At the meeting, the NFPA membership can consider and act on these Certified Amending Motions as well as Follow-up Amending Motions, that is, motions that become necessary as a result of a previous successful Amending Motion. (See 4.6.2 through 4.6.9 of *Regs* for a summary of the available Amending Motions and who may make them.) Any outstanding objection following action at an Association Technical Meeting (and any further Technical Committee consideration following successful Amending Motions, see *Regs* at 4.7) must be raised through an appeal to the Standards Council or it will be considered to be resolved.

VI. Step 3b: Documents Forwarded Directly to the Council. Where no Notice of Intent to Make a Motion (NITMAM) is received and certified in accordance with the Technical Meeting Convention Rules, the document is forwarded directly to the Standards Council for action on issuance. Objections are deemed to be resolved for these documents.

VII. Step 4a: Council Appeals. Anyone can appeal to the Standards Council concerning procedural or substantive matters related to the development, content, or issuance of any document of the Association or on matters within the purview of the authority of the Council, as established by the *Bylaws* and as determined by the Board of Directors. Such appeals must be in written form and filed with the Secretary of the Standards Council (see 1.6 of *Regs*). Time constraints for filing an appeal must be in accordance with 1.6.2 of the *Regs*. Objections are deemed to be resolved if not pursued at this level.

VIII. Step 4b: Document Issuance. The Standards Council is the issuer of all documents (see Article 8 of *Bylaws*). The Council acts on the issuance of a document presented for action at an Association Technical Meeting within 75 days from the date of the recommendation from the Association Technical Meeting, unless this period is extended by the Council (see 4.8 of *Regs*). For documents forwarded directly to the Standards Council, the Council acts on the issuance of the document at its next scheduled meeting, or at such other meeting as the Council may determine (see 4.5.6 and 4.8 of *Regs*).

IX. Petitions to the Board of Directors. The Standards Council has been delegated the responsibility for the administration of the codes and standards development process and the issuance of documents. However, where extraordinary circumstances requiring the intervention of the Board of Directors exist, the Board of Directors may take any action necessary to fulfill its obligations to preserve the integrity of the codes and standards development process and to protect the interests of the Association. The rules for petitioning the Board of Directors can be found in the *Regulations Governing Petitions to the Board of Directors from Decisions of the Standards Council* and in 1.7 of the *Regs*.

X. For More Information. The program for the Association Technical Meeting (as well as the NFPA website as information becomes available) should be consulted for the date on which each report scheduled for consideration at the meeting will be presented. For copies of the ROP and ROC as well as more information on NFPA rules and for up-to-date information on schedules and deadlines for processing NFPA documents, check the NFPA website (www.nfpa.org) or contact NFPA Codes & Standards Administration at (617) 984-7246.

2012 Fall Revision Cycle ROP Contents

by NFPA Numerical Designation

Note: Documents appear in numerical order.

TYPES OF ACTION

P Partial Revision **N** New Document **R** Reconfirmation **W** Withdrawal

2012 Fall Revision Cycle ROP
Committees Reporting

FORM FOR COMMENT ON NFPA REPORT ON PROPOSALS
2012 Fall Revision CYCLE
FINAL DATE FOR RECEIPT OF COMMENTS: 5:00 pm EDT, March 2, 2012

For further information on the standards-making process, please contact the Codes and Standards Administration at 617-984-7249 or visit www.nfpa.org/codes.

For technical assistance, please call NFPA at 1-800-344-3555.

FOR OFFICE USE ONLY

Log #: ______

Date Rec'd: ______

Please indicate in which format you wish to receive your ROP/ROC ☐ **electronic** ☐ **paper** ☒ **download**

(Note: If choosing the download option, you must view the ROP/ROC from our website; no copy will be sent to you.)

Date 8/1/200X **Name** John B. Smith **Tel. No.** 253-555-1234

Company ______ **Email** ______

Street Address 9 Seattle St. **City** Tacoma **State** WA **Zip** 98402

******If you wish to receive a hard copy, a street address MUST be provided. Deliveries cannot be made to PO boxes.***

Please indicate organization represented (if any) Fire Marshals Assn. of North America

1. (a) NFPA Document Title National Fire Alarm Code **NFPA No. & Year** NFPA 72, 200X ed.

(b) Section/Paragraph 4.4.1.1

2. Comment on Proposal No. (from ROP): 72-7

3. Comment Recommends (check one): ☐ new text ☐ revised text ☒ deleted text

4. Comment (include proposed new or revised wording, or identification of wording to be deleted): [Note: Proposed text should be in legislative format; i.e., use underscore to denote wording to be inserted (<u>inserted wording</u>) and strike-through to denote wording to be deleted (~~deleted wording~~).]

Delete exception.

5. Statement of Problem and Substantiation for Comment: (Note: State the problem that would be resolved by your recommendation; give the specific reason for your Comment, including copies of tests, research papers, fire experience, etc. If more than 200 words, it may be abstracted for publication.)

A properly installed and maintained system should be free of ground faults. The occurrence of one or more ground faults should be required to cause a 'trouble' signal because it indicates a condition that could contribute to future malfunction of the system. Ground fault protection has been widely available on these systems for years and its cost is negligible. Requiring it on all systems will promote better installations, maintenance and reliability.

6. Copyright Assignment

(a) ☒ **I am the author of the text or other material (such as illustrations, graphs) proposed in the Comment.**

(b) ☐ **Some or all of the text or other material proposed in this Comment was not authored by me. Its source is as follows:** (please identify which material and provide complete information on its source)

______

I hereby grant and assign to the NFPA all and full rights in copyright in this Comment and understand that I acquire no rights in any publication of NFPA in which this Comment in this or another similar or analogous form is used. Except to the extent that I do not have authority to make an assignment in materials that I have identified in (b) above, I hereby warrant that I am the author of this Comment and that I have full power and authority to enter into this assignment.

Signature (Required) John B Smith

PLEASE USE SEPARATE FORM FOR EACH COMMENT

Mail to: Secretary, Standards Council · National Fire Protection Association
1 Batterymarch Park · Quincy, MA 02169-7471 OR
Fax to: (617) 770-3500 OR Email to: proposals_comments@nfpa.org

FORM FOR COMMENT ON NFPA REPORT ON PROPOSALS
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FOR OFFICE USE ONLY

Log #: ______

Date Rec'd: ______

Please indicate in which format you wish to receive your ROP/ROC ☐ **electronic** ☐ **paper** ☐ **download**

(Note: If choosing the download option, you must view the ROP/ROC from our website; no copy will be sent to you.)

Date ______ **Name** ______ **Tel. No.** ______

Company ______ **Email** ______

Street Address ______ **City** ______ **State** ______ **Zip** ______

******If you wish to receive a hard copy, a street address MUST be provided. Deliveries cannot be made to PO boxes.***

Please indicate organization represented (if any) ______

1. (a) NFPA Document Title ______ **NFPA No. & Year** ______

(b) Section/Paragraph ______

2. Comment on Proposal No. (from ROP): ______

3. Comment Recommends (check one): ☐ new text ☒ revised text ☐ deleted text

4. Comment (include proposed new or revised wording, or identification of wording to be deleted): [Note: Proposed text should be in legislative format; i.e., use underscore to denote wording to be inserted (inserted wording) and strike-through to denote wording to be deleted (~~deleted wording~~).]

5. Statement of Problem and Substantiation for Comment: (Note: State the problem that would be resolved by your recommendation; give the specific reason for your Comment, including copies of tests, research papers, fire experience, etc. If more than 200 words, it may be abstracted for publication.)

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I hereby grant and assign to the NFPA all and full rights in copyright in this Comment and understand that I acquire no rights in any publication of NFPA in which this Comment in this or another similar or analogous form is used. Except to the extent that I do not have authority to make an assignment in materials that I have identified in (b) above, I hereby warrant that I am the author of this Comment and that I have full power and authority to enter into this assignment.

Signature (Required) ______

PLEASE USE SEPARATE FORM FOR EACH COMMENT

Mail to: Secretary, Standards Council · National Fire Protection Association
1 Batterymarch Park · Quincy, MA 02169-7471 OR
Fax to: (617) 770-3500 OR Email to: proposals_comments@nfpa.org

11/17/2011

COMMITTEE MEMBER CLASSIFICATIONS[1,2,3,4]

The following classifications apply to Committee members and represent their principal interest in the activity of the Committee.

1. M — Manufacturer: A representative of a maker or marketer of a product, assembly, or system, or portion thereof, that is affected by the standard.

2. U — User: A representative of an entity that is subject to the provisions of the standard or that voluntarily uses the standard.

3. IM — Installer/Maintainer: A representative of an entity that is in the business of installing or maintaining a product, assembly, or system affected by the standard.

4. L — Labor: A labor representative or employee concerned with safety in the workplace.

5. RT — Applied Research/Testing Laboratory: A representative of an independent testing laboratory or independent applied research organization that promulgates and/or enforces standards.

6. E — Enforcing Authority: A representative of an agency or an organization that promulgates and/or enforces standards.

7. I — Insurance: A representative of an insurance company, broker, agent, bureau, or inspection agency.

8. C — Consumer: A person who is or represents the ultimate purchaser of a product, system, or service affected by the standard, but who is not included in (2).

9. SE — Special Expert: A person not representing (1) through (8) and who has special expertise in the scope of the standard or portion thereof.

NOTE 1: “Standard” connotes code, standard, recommended practice, or guide.

NOTE 2: A representative includes an employee.

NOTE 3: While these classifications will be used by the Standards Council to achieve a balance for Technical Committees, the Standards Council may determine that new classifications of member or unique interests need representation in order to foster the best possible Committee deliberations on any project. In this connection, the Standards Council may make such appointments as it deems appropriate in the public interest, such as the classification of “Utilities” in the National Electrical Code Committee.

NOTE 4: Representatives of subsidiaries of any group are generally considered to have the same classification as the parent organization.

Sequence of Events Leading to Issuance of an NFPA Committee Document

Step 1 **Call for Proposals**

▼ Proposed new document or new edition of an existing document is entered into one of two yearly revision cycles, and a Call for Proposals is published.

Step 2 **Report on Proposals (ROP)**

▼ Committee meets to act on Proposals, to develop its own Proposals, and to prepare its Report.

▼ Committee votes by written ballot on Proposals. If two-thirds approve, Report goes forward. Lacking two-thirds approval, Report returns to Committee.

▼ Report on Proposals (ROP) is published for public review and comment.

Step 3 **Report on Comments (ROC)**

▼ Committee meets to act on Public Comments to develop its own Comments, and to prepare its report.

▼ Committee votes by written ballot on Comments. If two-thirds approve, Report goes forward. Lacking two-thirds approval, Report returns to Committee.

▼ Report on Comments (ROC) is published for public review.

Step 4 **Association Technical Meeting**

▼ *"Notices of intent to make a motion"* are filed, are reviewed, and valid motions are certified for presentation at the Association Technical Meeting. ("Consent Documents" that have no certified motions bypass the Association Technical Meeting and proceed to the Standards Council for issuance.)

▼ NFPA membership meets each June at the Association Technical Meeting and acts on Technical Committee Reports (ROP and ROC) for documents with "certified amending motions."

▼ Committee(s) vote on any amendments to Report approved at NFPA Annual Membership Meeting.

Step 5 **Standards Council Issuance**

▼ Notification of intent to file an appeal to the Standards Council on Association action must be filed within 20 days of the NFPA Annual Membership Meeting.

▼ Standards Council decides, based on all evidence, whether or not to issue document or to take other action, including hearing any appeals.

The Association Technical Meeting

The process of public input and review does not end with the publication of the ROP and ROC. Following the completion of the Proposal and Comment periods, there is yet a further opportunity for debate and discussion through the Association Technical Meeting that takes place at the NFPA Annual Meeting.

The Association Technical Meeting provides an opportunity for the final Technical Committee Report (i.e., the ROP and ROC) on each proposed new or revised code or standard to be presented to the NFPA membership for the debate and consideration of motions to amend the Report. The specific rules for the types of motions that can be made and who can make them are set forth in NFPA's rules, which should always be consulted by those wishing to bring an issue before the membership at an Association Technical Meeting. The following presents some of the main features of how a Report is handled.

The Filing of a Notice of Intent to Make a Motion. Before making an allowable motion at an Association Technical Meeting, the intended maker of the motion must file, in advance of the session, and within the published deadline, a Notice of Intent to Make a Motion. A Motions Committee appointed by the Standards Council then reviews all notices and certifies all amending motions that are proper. The Motions Committee can also, in consultation with the makers of the motions, clarify the intent of the motions and, in certain circumstances, combine motions that are dependent on each other together so that they can be made in one single motion. A Motions Committee report is then made available in advance of the meeting listing all certified motions. Only these Certified Amending Motions, together with certain allowable Follow-Up Motions (that is, motions that have become necessary as a result of previous successful amending motions) will be allowed at the Association Technical Meeting.

Consent Documents. Often there are codes and standards up for consideration by the membership that will be noncontroversial and no proper Notices of Intent to Make a Motion will be filed. These “Consent Documents” will bypass the Association Technical Meeting and head straight to the Standards Council for issuance. The remaining documents are then forwarded to the Association Technical Meeting for consideration of the NFPA membership.

What Amending Motions Are Allowed. The Technical Committee Reports contain many Proposals and Comments that the Technical Committee has rejected or revised in whole or in part. Actions of the Technical Committee published in the ROP may also eventually be rejected or revised by the Technical Committee during the development of its ROC. The motions allowed by NFPA rules provide the opportunity to propose amendments to the text of a proposed code or standard based on these published Proposals, Comments, and Committee actions. Thus, the list of allowable motions include motions to accept Proposals and Comments in whole or in part as submitted or as modified by a Technical Committee action. Motions are also available to reject an accepted Comment in whole or part. In addition, Motions can be made to return an entire Technical Committee Report or a portion of the Report to the Technical Committee for further study.

The NFPA Annual Meeting, also known as the NFPA Conference & Expo, takes place in June of each year. A second Fall membership meeting was discontinued in 2004, so the NFPA Technical Committee Report Session now runs once each year at the Annual Meeting in June.

Who Can Make Amending Motions. NFPA rules also define those authorized to make amending motions. In many cases, the maker of the motion is limited by NFPA rules to the original submitter of the Proposal or Comment or his or her duly authorized representative. In other cases, such as a Motion to Reject an accepted Comment, or to Return a Technical Committee Report or a portion of a Technical Committee Report for Further Study, anyone can make these motions. For a complete explanation, the NFPA Regs should be consulted.

Action on Motions at the Association Technical Meeting. In order to actually make a Certified Amending Motion at the Association Technical Meeting, the maker of the motion must sign in at least an hour before the session begins. In this way a final list of motions can be set in advance of the session. At the session, each proposed document up for consideration is presented by a motion to adopt the Technical Committee Report on the document. Following each such motion, the presiding officer in charge of the session opens the floor to motions on the document from the final list of Certified Amending Motions followed by any permissible Follow-Up Motions. Debate and voting on each motion proceeds in accordance with NFPA rules. NFPA membership is not required in order to make or speak to a motion, but voting is limited to NFPA members who have joined at least 180 days prior to the Association Technical Meeting and have registered for the meeting. At the close of debate on each motion, voting takes place, and the motion requires a majority vote to carry. In order to amend a Technical Committee Report, successful amending motions must be confirmed by the responsible Technical Committee, which conducts a written ballot on all successful amending motions following the meeting and prior to the document being forwarded to the Standards Council for issuance.

Standards Council Issuance

One of the primary responsibilities of the NFPA Standards Council, as the overseer of the NFPA codes and standards development process, is to act as the official issuer of all NFPA codes and standards. When it convenes to issue NFPA documents, it also hears any appeals related to the document. Appeals are an important part of assuring that all NFPA rules have been followed and that due process and fairness have been upheld throughout the codes and standards development process. The Council considers appeals both in writing and through the conduct of hearings at which all interested parties can participate. It decides appeals based on the entire record of the process as well as all submissions on the appeal. After deciding all appeals related to a document before it, the Council, if appropriate, proceeds to issue the document as an official NFPA code or standard. Subject only to limited review by the NFPA Board of Directors, the decision of the Standards Council is final, and the new NFPA code or standard becomes effective twenty days after Standards Council issuance.

Report of the Committee on

National Electrical Code®

Michael J. Johnston, *Chair*
National Electrical Contractors Association, MD [IM]

Jean A. O'Connor, *Secretary (Nonvoting)*
National Fire Protection Association, MA

Mark W. Earley, *Secretary (Staff-Nonvoting)*
National Fire Protection Association, MA

James E. Brunssen, Telcordia, NJ [UT]
Rep. Alliance for Telecommunications Industry Solutions

Merton W. Bunker, Jr., US Department of State, VA [U]
William R. Drake, Actuant Electrical, CA [M]
William T. Fiske, Intertek Testing Services, NY [RT]
Palmer L. Hickman, National Joint Apprentice & Training Committee, MD [L]
Rep. International Brotherhood of Electrical Workers
David L. Hittinger, Independent Electrical Contractors of Greater Cincinnati, OH [IM]
Rep. Independent Electrical Contractors, Inc.
Daniel J. Kissane, Legrand/Pass & Seymour, NY [M]
Rep. National Electrical Manufacturers Association
John R. Kovacik, Underwriters Laboratories Inc., IL [RT]
Neil F. LaBrake, Jr., National Grid, NY [UT]
Rep. Electric Light & Power Group/EEI
Danny Liggett, The DuPont Company, Inc., TX [U]
Rep. American Chemistry Council
Richard P. Owen, Oakdale, MN [E]
Rep. International Association of Electrical Inspectors

Alternates

Thomas L. Adams, Engineering Consultant, IL [UT]
(Alt. to Neil F. LaBrake, Jr.)
Lawrence S. Ayer, Biz Com Electric, Inc., OH [IM]
(Alt. to David L. Hittinger)
James T. Dollard, Jr., IBEW Local Union 98, PA [L]
(Alt. to Palmer L. Hickman)
Stanley J. Folz, Morse Electric Company, NV [IM]
(Alt. to Michael J. Johnston)
Ernest J. Gallo, Telcordia Technologies, Inc., NJ [UT]
(Alt. to James E. Brunssen)
Robert A. McCullough, Tuckerton, NJ [E]
(Alt. to Richard P. Owen)
Michael E. McNeil, FMC Bio Polymer, ME [U]
(Alt. to Danny Liggett)
Mark C. Ode, Underwriters Laboratories Inc., AZ [RT]
(Alt. to John R. Kovacik)

Nonvoting

Timothy J. Pope, Canadian Standards Association, Canada [SE]
Rep. CSA/Canadian Electrical Code Committee
Richard G. Biermann, Biermann Electric Company, Inc., IA [IM]
(Member Emeritus)
D. Harold Ware, Libra Electric Company, OK [IM]
(Member Emeritus)

Staff Liaison: **Mark W. Earley**

Committee Scope: This Committee shall have primary responsibility for documents on minimizing the risk of electricity as a source of electric shock and as a potential ignition source of fires and explosions. It shall also be responsible for text to minimize the propagation of fire and explosions due to electrical installations.

Report of the Committee on

Electrical Equipment Maintenance

Alan Manche, *Chair*
Square D Company/Schneider Electric, KY [M]
Rep. National Electrical Manufacturers Association

Richard Bingham, Dranetz-BMI, NJ [M]
Thomas H. Bishop, Electrical Apparatus Service Association, MO [IM]
Timothy Crnko, Cooper Bussmann, MO [M]
Jeffrey Hall, Underwriters Laboratories Inc., NC [RT]
Palmer L. Hickman, National Joint Apprentice & Training Committee, MD [L]
Rep. International Brotherhood of Electrical Workers
Mark C. Horne, Georgia Power Company, GA [U]
Rep. Electric Light & Power Group/EEI
Ahmad A. Moshiri, Liebert Corporation, OH [M]
Ronald K. Mundt, US Army Corps of Engineers, VA [U]
Erik G. Olsen, Chubb Group of Insurance Companies, NJ [I]
Kenneth J. Rempe, Siemens Industry Inc., GA [M]
Rep. National Electrical Manufacturers Association
Robert Urdinola, US Department of State, DC [U]
Michael Velvikis, High Voltage Maintenance Corporation, WI [IM]
Rep. InterNational Electrical Testing Association
James R. White, Shermco Industries, Inc., TX [IM]
Bruce G. Wyman, Mount Snow Ltd., VT [U]

Alternates

Leonard Fiume, National Grid, NY [U]
(Alt. to Mark C. Horne)
David Goodrich, Liebert Corporation, OH [M]
(Alt. to Ahmad A. Moshiri)
David Huffman, Power Systems Testing Company, CA [IM]
(Alt. to Michael Velvikis)
Christopher E. Kelly, JATC for Nassau & Suffolk Counties, NY [L]
(Alt. to Palmer L. Hickman)
Greg T. Nienaber, Connector Manufacturing Company, OH [M]
(Alt. to Kenneth J. Rempe)
Ron Widup, Shermco Industries, Inc., TX [IM]
(Alt. to James R. White)

Nonvoting

Albert J. Reed, Macungie, PA
(Member Emeritus)

Staff Liaison**: Michael Fontaine**

Committee Scope: This Committee shall have the primary responsibility for documents relating to preventive maintenance of electrical, electronic, and communications systems and equipment used in industrial and commercial type applications with the view of: (1) reducing loss of life and property, and (2) improving reliability, performance, and efficiency in a cost-effective manner. The purpose is to provide generally applicable procedures for preventive maintenance that have broad application to the more common classes of industrial and commercial systems and equipment without duplicating or superseding instructions that manufacturers normally provide. This Committee shall report to Technical Correlating Committee of the National Electrical Code.

These lists represent the membership at the time each Committee was balloted on the text of this report. Since that time, changes in the membership may have occurred. A key to classifications is found at the front of the document.

The Report of the Committee on **Electrical Equipment Maintenance** is presented for adoption, as follows:

This Report was prepared by the **Technical Committee on Electrical Equipment Maintenance** and proposes for adoption, amendments to NFPA 70B, **Recommended Pratice for Electrical Equipment Maintenance,** 2010 edition. NFPA 70B-2010 is published in Volume 16 of the 2011 National Fire Codes and in separate pamphlet form.

This Report has been submitted to letter ballot of the **Technical Committee on Electrical Equipment Maintenance,** which consists of 15 voting members. The results of the balloting, after circulation of any negative votes, can be found in the report.

This Report on Proposals has also been submitted to the **Technical Correlating Committee on National Electrical Code** (TCC) in two parts. Part I is a letter ballot on the TCC Actions, if any; and Part II is an informational letter ballot on the Report as a whole. The TCC, which consists of 12 voting members, voted as follows:

Part I: 12 voted affirmatively.

Mr. Hickman voted affirmatively with this comment stating:
The TCC note on proposal 42b should be revised as follows:
The Technical Correlating Committee directs that the committee review the proposed text and reference NFPA 70 for prescriptive grounding requirements. This shall be considered as a public comment.

Part II: 12 voted affirmatively.

70B-1 Log #CP1 EEM-AAA **Final Action: Accept**
(Entire Document)

Submitter: Technical Committee on Electrical Equipment Maintenance,
Recommendation: Review entire document to: 1) Update any extracted material by preparing separate proposals to do so, and 2) review and update references to other organizations documents, by preparing proposal(s) as required.
Substantiation: To conform to the NFPA Regulations Governing Committee Projects.
Committee Meeting Action: Accept
Committee Statement: The committee actions on 70B-1a (Log #CP10), 70B-84 (Log #CP12), and 70B-85 (Log #CP13) addresses the requested and required action.
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-1a Log #CP10 EEM-AAA **Final Action: Accept**
(2.2, 2.3)

Submitter: Technical Committee on Electrical Equipment Maintenance,
Recommendation: Revise the references in 2.2 and 2.3 as follows:
2.2 NFPA Publications. The documents or portions thereof listed in this chapter are referenced within this recommended
practice and should be considered part of the recommendations of this document.
NFPA 70®, National Electrical Code®, ~~2008~~ 2011 edition.
NFPA 70E®, Standard for Electrical Safety in the Workplace®, ~~2009~~ 2012 edition.
NFPA 110, *Standard for Emergency and Standby Power Systems,* 2010 edition.
NFPA 496, *Standard for Purged and Pressurized Enclosures for Electrical Equipment,* 2008 edition.
NFPA 1600®, Standard on Disaster/Emergency Management and Business Continuity Programs, 2010 edition.
2.3 Other Publications.
~~**2.3.1 ANSI Publications.** American National Standards Institute,Inc., 25 West 43rd Street, 4th Floor, New York, NY 10036.~~
~~ANSI/EASA AR100, *Recommended Practice for the Repair of Rotating Electrical Apparatus*, 2001.~~
2.3.1~~2~~ ASTM Publications. American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA
19428-2959.
ASTM D 92-05a(2010), *Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester.* ~~, 2005a~~
ASTM D 445-11a, *Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity),* ~~2009~~.
ASTM D 664 - 11, *Standard Test Method for Acid Number of Petroleum Products by Potentiometric Titration.* ~~, 2001.~~
ASTM D 877-02 (2007), *Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes.*~~, 2002~~.
ASTM D 923-07, *Standard ~~Test Method~~ Practices for Sampling Electrical Insulating Liquids*, 1997.
ASTM D 924 -08, *Standard Test Method for Dissipation Factor (or Power Factor) and Relative Permittivity (Dielectric Constant) of Electrical Insulating Liquids.* ~~, 2003.~~
ASTM D 971-99a (2004), *Standard Test Method~~s~~ for Interfacial Tension of Oil Against Water by the Ring Method.* ~~, 1999a~~.
ASTM D 974-02, *Standard Test Methods for Acid and Base Number by Color-Indicator Titration.* ~~, 2002.~~
ASTM D 1298-99(2005), *Standard Test Method for Density, Relative Density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method.* ~~, 2005.~~
ASTM D 1500-07, *Standard Test Method for ASTM Color of Petroleum Products (ASTM Color Scale).* ~~, 2002.~~
ASTM D 1524-94 (1999), *Standard Test Method for Visual Examination of Used Electrical Insulating Oils of Petroleum Origin in the Field.* ~~, 1994 (1999).~~
ASTM D 1533-00(2005), *Standard Test Method for Water in Insulating Liquids by Coulometric Karl Fischer Titration.* ~~, 2005.~~
ASTM D 1816-04, *Standard Test Method for Dielectric Breakdown Voltage of Insulating Oils of Petroleum Origin Using VDE Electrodes.* ~~, 1997.~~
ASTM D 2129-05(2010), *Standard Test Method for Color of Clear Electrical Insulating Liquids (Platinum-Cobalt Scale).* ~~, 2005.~~
ASTM D 2285-99, *Standard Test Method for Interfacial Tension of Electrical Insulating Oils of Petroleum Origin Against Water by the Drop-Weight Method.* ~~, 1999.~~
ASTM D 2472-00 (2006), *Standard Specification for Sulfur Hexafluoride.* ~~, 2000.~~
ASTM D 3284-05 (2011), *Standard ~~Test Methods~~ Practice for Combustible Gases in the Gas Space of Electrical Apparatus Using Portable Meters.* ~~*in the Field,* 1999.~~
ASTM D 3612-02 (2009), *Standard Test Method for Analysis of Gases Dissolved in Electrical Insulating Oil by Gas Chromatography.* ~~, 2002.~~
2.3.2 **EASA Publications**. Electrical Apparatus Service Association, 1331 Baur Blvd, St. Louis, MO 63132.
ANSI/EASA AR100, *Recommended Practice for the Repair of Rotating Electrical Apparatus*, 2010.
2.3.3 IEEE Publications. Institute of Electrical and Electronics Engineers, Three Park Avenue, 17th Floor, New York, NY 10016-5997.
ANSI/IEEE 43 ~~(R 1991)~~, *Recommended Practice for Testing Insulation Resistance of Rotating Machinery*, 2000.
ANSI/IEEE 80, *Guide for Safety in AC Substation Grounding*, ~~1986~~ 2000.
IEEE 81, *Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Ground System,* 1983.
ANSI/IEEE 95, *Recommended Practice for Insulation Testing of AC Electric Machinery (2300 V and Above) with High Direct Voltage*, 2002.
ANSI/IEEE 141, *Recommended Practice for Electric Power Distribution for Industrial Plants* (Red Book), 1993.
ANSI/IEEE 142, *Recommended Practice for Grounding of Industrial and Commercial Power Systems* (Green Book), ~~1991~~ 2007.
ANSI/IEEE 241, *Recommended Practice for Electric Power Systems in Commercial Buildings* (Gray Book), 1990.
ANSI/IEEE 242, *Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems* (Buff Book), ~~1986 (reaff. 1991)~~ 2001.
ANSI/IEEE 399, *Recommended Practice for Industrial and Commercial Power Systems Analysis* (Brown Book), 1990.
ANSI/IEEE 400, ~~*Guide for Making High-Direct-Voltage Tests on Power Cable Systems in the Field*~~ *Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems*, ~~1991~~ 2001.
IEEE 400.1, *Guide for Field Testing of Laminated Dielectric, Shielded Power Cable Systems Rated 5kV and Above with High Direct Current Voltage,* 2007.
IEEE 400.2, *Guide for Field Testing of Shielded Power Cable Systems Using Very Low Frequency (VLF),* 2004.
IEEE 400.3, *Guide for Partial Discharge Testing of Shielded Power Cable Systems in a Field Environment,* 2006.
ANSI/IEEE 446, *Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications (IEEE Orange Book),* 1995.
ANSI/IEEE 450, *Recommended Practice for Maintenance, Testing and Replacement of Vented Lead-Acid Batteries for Stationary Applications* ~~*Large Lead Storage Batteries for Generating Stations and Substations,* 2002~~ 2010.
ANSI/IEEE 493, *Recommended Practice for the Design of Reliable Industrial and Commercial Power Systems* (Gold Book), ~~1990~~ 2007.
ANSI/IEEE 519, *Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems*, 1992.
IEEE 637, *Guide for Reclamation of Insulating Oil and Criteria for Its Use,* 1985.
ANSI/IEEE 1100, *Recommended Practice for Powering and Grounding* ~~*Sensitive*~~ *Electronic Equipment* (Emerald Book), ~~1992~~ 2005.
IEEE 1106, *Recommended Practice for Installation, Maintenance, Testing and Replacement of Vented Nickel-Cadmium Batteries for Stationary Applications,* ~~1995~~ 2005.
IEEE 1125, *Guide for Moisture Measurement and Control in SF6 Gas-Insulated Equipment*, 1993 (R 2000).
IEEE 1159, *Recommended Practice on Monitoring Electric Power Quality*, ~~1995~~ 2009.
IEEE 1188, *Recommended Practice for Maintenance, Testing and Replacement of Valve-Regulated Lead Acid (VRLA) Batteries for Stationary Applications,* 2005.
ANSI C2, *National Electrical Safety Code,* 2007.
ANSI/IEEE C37.13, *Standard for Low-Voltage AC Power Circuit Breakers Used in Enclosures*, ~~1990~~ 2008.
IEEE C37.20.1, *Standard for Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear*, 2002.
IEEE C37.23, *Standard for Metal-Enclosed Bus* ~~*and Calculating Losses in Isolated-Phase Bus*, 1987 (reaff. 1991)~~ 2003.
IEEE C37.122.1, *IEEE Guide for Gas-Insulated Substations*, 1993 (R 2002).
ANSI/IEEE C57.104, *Guide for the Interpretation of Gases Generated in Oil-Immersed Transformers*, ~~1991~~ 2008.
ANSI/IEEE C57.106, *Guide for Acceptance and Maintenance of Insulating Oil in Equipment,* ~~2002~~ 2006.
ANSI/IEEE C57.110, *Recommended Practice for Establishing Liquid-Filled and Dry-Type Power and Distribution Transformer Capability When Supplying Nonsinusoidal Load Currents*, ~~1986 (reaff. 1993)~~ 2008.
ANSI/IEEE C57.111, *Guide for Acceptance of Silicone Insulating Fluid and Its Maintenance in Transformers,* 1989 (R1995).
ANSI/IEEE C57.121, *Guide for Acceptance and Maintenance of Less-Flammable Hydrocarbon Fluid in Transformers,* 1998.
2.3.4 ITI Publications. Information Technology Industry Council, 1250 Eye Street NW, Suite 200,Washington, DC 20005. 202-737-8880. http://www.itic org.
ITI (CBEMA) Curve Application Note, 2000.
2.3.5 NEMA Publications. National Electrical Manufacturers Association, 1300 North 17th Street, Suite 1847, Rosslyn, VA 22209.
NEMA AB 1~~-99~~, *Molded Case Circuit Breakers,* ~~*and*~~ *Molded Case Switches, and Circuit Breaker Enclosures* ~~1999~~ (Equivalent to the current edition of UL 489).

ANSI/NEMA AB 4, *Guidelines for Inspection and Preventive Maintenance of Molded-Case Circuit Breakers Used in Commercial and Industrial Applications*, 2009.
ANSI/NEMA C84.1, *Electric Power Systems and Equipment, Voltage Ratings (60 Hertz),* ~~1995~~ 2006.
NEMA MG 1, *Motors and Generators*, ~~2003~~ 2009 (R 2010).
ANSI/NEMA PB 2.1, *General Instructions for Proper Handling, Installation, Operation, and Maintenance of Dead Front Distribution Switchboards Rated 600 Volts or Less,* 2007.
NEMA SG 6, *Power Switching Equipment*, 2000.
NEMA WD 6, ~~*Wiring Devices—Dimensional Requirements*~~ *Dimensions for Wiring Devices*, ~~1997~~ 2002 (R2008).
NEMA ~~*Guidelines for Handling*~~ *Evaluating Water-Damaged Electrical Equipment*,
~~2005~~ 2006.
2.3.6 NETA Publications. InterNational Electrical Testing Association, P.O. Box 687, Morrison, CO 80465.
ANSI/NETA ATS-2009, *Acceptance Testing Specification for Electrical Power Distribution Equipment and Systems*. ~~, ATS-2003.~~
ANSI/NETA MTS-2011, *Maintenance Testing Specifications for Electrical Power Distribution Equipment and Systems*. ~~, MTS-2001.~~
2.3.7 UL Publications. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.
ANSI/UL 489, *Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures*, Tenth edition, 2002,
~~(R 2006)~~ Revised 2011.
ANSI/UL 943, *Standard for Ground-Fault Circuit Interrupters*, 2006, ~~(R 2008)~~ Revised 2010.
UL 1436, *Outlet Circuit Testers and Similar Indicating Devices*, ~~4th edition, 1998, (R 2004)~~ 2004.
2.3.8 U.S. Government Publications. U.S. Government Printing Office,Washington, DC 20402-9328.
Title 29, Code of Federal Regulations, Part 1910.
Title 29, Code of Federal Regulations, Part 1926.
Title 29, Code of Federal Regulations, Part 1910.94(a), "Occupational Health and Environmental Control—Ventilation."
Title 29, Code of Federal Regulations, Part 1910.146, "Permit-Required Confined Spaces."
Title 29, Code of Federal Regulations, Part 1910.242(b), "Hand and Portable Powered Tools and Other Hand Held Equipment."
Title 29, Code of Federal Regulations, Part 1910.269, "Electric Power Generation, Transmission, and Distribution," Paragraph (e), Enclosed Spaces.
Title 29, Code of Federal Regulations, Parts 1910.331 through 1910.335, "Safety Related Work Practices."
Title 40, Code of Federal Regulations, Part 761, "Protection of Environment — Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions."
TM 5-694, *Commissioning of Electrical Systems for Command, Control, Communications, Computer, Intelligence, Surveillance, and Reconnaissance (C4ISR) Facilities,* 2006.
TM 5-698-1, *Reliability/Availability of Electrical and Mechanical Systems for Command, Control, Communications, Computer, Intelligence, Surveillance, and Reconnaissance (C4ISR) Facilities*, 2003.
2.3.9 Other Publications.
Merriam-Webster's Collegiate Dictionary, 11th edition, Merriam-Webster, Inc., Springfield, MA, 2003.
ABB Power T & D Company, Inc., *Instruction Book PC-2000 for Wecosol™ Fluid-Filled Primary and Secondary Unit Substation Transformers*.
NFPA 70®, *National Electrical Code®*, ~~2008~~ 2011 edition
The committee directs NFPA staff to revise document titles across the entire document to conform with the titles in proposal.
Substantiation: Updated references to reflect current editions and titles.
Committee Meeting Action: Accept
Committee Statement: The committee intends to check the references again at the comment stage.
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-2 Log #37 EEM-AAA **Final Action: Accept in Principle**
(2.3.7)

Submitter: John F. Bender, Underwriters Laboratories Inc.
Recommendation: Revise text as follows:
2.3.7 UL Publications. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.
ANSI/UL 489, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures, Tenth edition, 2002, ~~(R 2006)~~ 2009.
ANSI/UL 943, Standard for Ground-Fault Circuit Interrupters, 2006, ~~(R 2008)~~ Revised 2010.
UL 1436, Outlet Circuit Testers and Similar Indicating Devices, ~~4th edition, 1998, (R 2004)~~ 2004.
Substantiation: Add ANSI approval designation to ANSI/UL 943 and update referenced standards to most recent revision.
Committee Meeting Action: Accept in Principle
Revise the text of the recommendation to read as follows:
2.3.7 UL Publications. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.
ANSI/UL 489, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures, Eleventh~~Tenth~~ edition, ~~2002, (R 2006)~~ 2009, (R 2011).
ANSI/UL 943, Standard for Ground-Fault Circuit Interrupters, 2006, ~~(R 2008)~~ Revised (R 2010).
UL 1436, Outlet Circuit Testers and Similar Indicating Devices, ~~4th edition, 1998, (R 2004)~~ 2004.
Committee Statement: The committee actions corrects the edition of ANSI/UL 489 and ANSI/UL 943.
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-2a Log #CP11 EEM-AAA **Final Action: Accept**
(3.3.1 Arc Flash Hazard and 3.3.2 Arc Flash Hazard Analysis (new))

Submitter: Technical Committee on Electrical Equipment Maintenance,
Recommendation: Add the following new definitions:
3.3.1 Arc Flash Hazard. A dangerous condition associated with the possible release of energy caused by an electric arc. [70E, 2012]
3.3.2 Arc Flash Hazard Analysis. A study investigating a worker's potential exposure to arc-flash energy, conducted for the purpose of injury prevention and the determination of safe work practices, arc flash protection boundary, and the appropriate levels of PPE. [70E, 2012]
Renumber all subsequent definitions.
Substantiation: Definition extracted from NFPA 70E as basis for another proposal in chapter 9.6.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-3 Log #35 EEM-AAA **Final Action: Reject**
(3.3.36 Ground-Fault Circuit Interrupter (GFCI))

Submitter: John F. Bender, Underwriters Laboratories Inc.
Recommendation: Revise text as follows:
3.3.36* Ground-Fault Circuit Interrupter (GFCI). A device intended for the protection of personnel that functions to deenergize a circuit or portion thereof within an established period of time when a current to ground exceeds the values established for a Class A device. Note: Class A Ground-Fault Circuit Interrupters trip when the current to ground has a value in the range of 4 mA to 6 mA. For further information, see ANSI/UL 943, *Standard for Ground-Fault Circuit Interrupters*. [70, 2008].
Substantiation: Add ANSI approval designation to ANSI/UL 943.
Committee Meeting Action: Reject
Committee Statement: The committee rejects this proposal because the extracted definition from the NEC does not include the ANSI designation.
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-4 Log #1 EEM-AAA **Final Action: Reject**
(5.2)

Note: This proposal appeared as Comment 70B-2 (Log #57) which was held from the Fall 2009 ROC on Proposal 70B-7.
Submitter: Michael A. Anthony, University of Michigan
Recommendation: Add item (3) as shown below.
5.2 Essential Elements of an EPM Program.
An EPM program should consist of the following essential elements:
(1) Responsible and qualified personnel
(2) Regularly scheduled inspection, testing and servicing of equipment
(3) Inspection testing and servicing of equipment informed by a risk assessment and structured according to the conditioned-based maintenance methods described in Annex K.
Substantiation: Regular, fixed interval testing is not necessarily risk-informed. Fixed interval testing, while easy to document, schedule and verify does always produce the intended result. Fixed interval testing can be over-testing, resulting in reduced resources available for more critical systems – in addition to increasing the likelihood of maintenance induced accidents and errors. Fixed interval testing may also have the unintended effect of retarding innovation in products by transferring the cost of the useful life of the product to the Owner rather than building it into the inherent life-cycle value of the product itself.
Acceptance of this comment will create a link between Annex K and the main body of this document and will suggest other ways to rationalize a preventive maintenance budget with the nature and condition of the system or occupancy.
Committee Meeting Action: Reject

Committee Statement: The committee finds that the present clause is adequate as written because the current language generically covers utilizing these tools.
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-5 Log #2 EEM-AAA **Final Action: Reject**
(5.3.4.1)

Note: This proposal appeared as Comment 70B-3 (Log #56) which was held from the Fall 2009 ROC on Proposal 70B-6.
Submitter: Michael A. Anthony, University of Michigan
Recommendation: Add text as shown follows:
5.3.4.1 Design for Ease of Maintenance. Effective electrical preventive maintenance begins with good design. In the design of new facilities, a conscious effort to ensure optimum maintainability is recommended. Dual circuits, tie circuits, auxiliary power sources, and drawout protective devices make it easier to schedule maintenance and to perform maintenance work with minimum interruption of production. Other effective design techniques include equipment rooms to provide environmental protection, grouping of equipment for more convenience and accessibility, grouping of load classes on a dedicated circuit and standardization of equipment and components.
Substantiation: Mixed load classes on medium voltage circuits are common in campus-style facilities. The condition evolves over time because of the increased cost of running bulk distribution circuits to buildings of the same occupancy type. Over time then, library and classroom buildings are on the same supply circuit as high rise health care and public safety office buildings; parking structures on the same circuit as central chiller plants that provide mission critical power. To the extent possible, planners of campus medium voltage distribution systems should try to partition these load classes – if for no other reason than to prioritize a load shedding regime back at the distribution switchgear in the district energy plant. Grouping of load classes would manage the economic affect of forced outages which will indirectly affect the manner in which restoration and maintenance objectives are achieved.
Committee Meeting Action: Reject
Committee Statement: The committee rejects because the previous phrase is encompassing the concept.
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-6 Log #3 EEM-AAA **Final Action: Reject**
(6.1.2(2))

Note: This proposal appeared as Comment 70B-4 (Log #58) which was held from the Fall 2009 ROC on Proposal 70B-8.
Submitter: Michael A. Anthony, University of Michigan
Recommendation: Modify punctuation and add the words "and occupancies" as shown in underline below.
6.1.2 The following four basic steps should be taken in the planning and development of an EPM program. In their simplest form, they are as follows:
(1) Compile a listing of all equipment and systems.
(2) Determine which equipment, ~~and~~ systems **and occupancies** are most critical ~~and most important.~~
Substantiation: An electrical preventive maintenance program should be scaled to the risk to the occupancy. Many adopting organizations have virtually no additional money to comply with 70B recommendations but are opting to prioritize and to allocate resources to where the risk is greatest and where the probability of reducing adverse consequences is greatest. Some of the criteria that could be used by AHJ's and insurance companies are:
● Facility classification. A distinction should be made between general business occupancies and health care and high-rise facilities. A preventive maintenance program for a college campus would be more robust in a place of assembly than in an off-site book storage warehouse.
● Permanent maintenance staff. A supervised installation may be more watchful of the conditions of maintenance and supervision; would be most familiar with baseline data and incident logs, and IT&M sampling strategies.
● Overall characteristics of the electrical system. The age of the system, availability of spare parts, and the nature of its supply source; system redundancy.
Committee Meeting Action: Reject
Committee Statement: The committee rejects because the concept recommended is already covered and there is no substantiation for deleting the words "and most important."
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-7 Log #73 EEM-AAA **Final Action: Reject**
(6.3.1.2.x (New))

Submitter: Michael A. Anthony, University of Michigan / Rep. APPA.ORG - Leadership in Education - Association of Education Facility Executives
Recommendation: Add new text as shown below:
6.3.1.2 The team should review the entire plant or each of its operating segments in detail, considering each unit of equipment as related to the entire operation and the effect of its loss on safety and production.
6.3.1.2.x Each branch circuit and feeder should be visibly and permanently marked to distinguish whether or not the end use equipment supplied from it is an emergency power load or a standby power load. The distinction may assist electricians determine which circuits may be de-energized in emergency and/or or maintenance conditions.
Substantiation: Electricians are frequently reluctant to de-energize circuits for maintenance or load-shedding operations because they do not know enough about the end-use equipment. Identifying circuits according to priority -- and making this identification a permanent part of the maintenance program -- may enable safer, and more economical maintenance.
Committee Meeting Action: Reject
Committee Statement: The committee rejects because the NEC already addresses the minimum marking requirements and does not prohibit more expansive marking requirements.
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-7a Log #CP16 EEM-AAA **Final Action: Accept**
(6.10 (New))

Submitter: Technical Committee on Electrical Equipment Maintenance,
Recommendation: Add new section 6.10 to read as follows:
6.10 **Counterfeit Components, Devices, Tools, and Equipment**.
6.10.1 When the maintenance of electrical equipment requires the replacement of existing components, devices, tools, or equipment, care should be exercised to minimize the inadvertent use or installation of counterfeit goods.
6.10.2 Products should be purchased from an authorized vendor.
6.10.3 Careful visual inspection of the goods and packaging can distinguish counterfeit goods from those of the legitimate manufacturer. The product and/or packaging may contain grammatical or spelling errors, missing or improper certification marks, lack of applicable safety warnings and instructions.
6.10.4 If it is suspected that the goods a counterfeit contact manufacturer or nationally recognized testing laboratory (NRTL).
Substantiation: The industry has seen an increase in the sale of counterfeit components, devices, tools, and equipment in the market. Counterfeit products often are difficult to distinguish from the general appearance, but may fail to operate properly, which can result in damage to other equipment and/or life.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.
Comment on Affirmative:
BINGHAM, R.: 6.10.4 typos on spelling of 'are' and missing comma. should read ...goods are counterfeit, contact....

70B-8 Log #74 EEM-AAA **Final Action: Reject**
(8.1.1.1.x (New))

Submitter: Michael A. Anthony, University of Michigan / Rep. APPA.ORG - Leadership in Education - Association of Education Facility Executives
Recommendation: Add new text as shown below:
8.1.1.1 Many maintenance tasks require equipment to be deenergized for effective results.
8.1.1.1.x PPE or hearing protection is not required for maintenance tasks that are performed on de-energized equipment and placed in an electrically safe condition by qualified persons.
Substantiation: Seems obvious; but the 70-series of documents have given so much attention to electrical safety while working on energized equipment over the past 15 years that the advantages of working on de-energized equipment have gotten lost in the discussion.
Committee Meeting Action: Reject
Committee Statement: The committee rejects because the substantiation is insufficient and PPE is addressed in Section 130.7 of NFPA 70E, and there may be other requirements for hearing protection. PPE may be required on de-energized equipment.
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-8a Log #CP14 EEM-AAA **Final Action: Accept**
(9.1)

Submitter: Technical Committee on Electrical Equipment Maintenance,
Recommendation: Revise by adding text on Arc Flash Hazard
9.1 Introduction. Electrical studies are an integral part of system design, operations, and maintenance. These engineering studies generally cover the following ~~four~~ areas:
(1) Short-circuit studies
(2) Coordination studies
(3) Load-flow studies
(4) Reliability studies
(5) Arc Flash Hazard Analysis Study
Substantiation: OSHA requires that electrical workers be protected from the hazards of the job and that a written hazard analysis be performed. An arc flash hazard is one of such hazards that need to be analyzed before performing electrical maintenance work.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-8b Log #CP15 EEM-AAA **Final Action: Accept**
(9.6)

Submitter: Technical Committee on Electrical Equipment Maintenance,
Recommendation: Add new text as follows:
9.6 Arc Flash Hazard Analysis Studies
9.6.1 An arc flash hazard analysis study is conducted on facility electrical systems to determine for each designated piece of electrical equipment the arc flash protection boundary and the personal protective equipment that people working within the arc flash protection boundary use. This is an important consideration for electrical safe work practices. Refer to Chapter 3 for definitions of arc flash hazard and arc flash hazard analysis.
9.6.2 The benefit of arc-flash hazard analysis is being able to provide the necessary information to a qualified electrical worker so that proper safe work practices can be followed if the worker has to work on or near electrical equipment not in an electrically safe work condition.
9.6.3 In order to do an arc flash hazard analysis the available short-circuit current at each designated piece of electrical equipment is necessary as well as the time-current characteristics for the upstream overcurrent protective supplying the equipment. *NFPA 70E Standard for Electrical Safety in the Workplace* and OSHA provides the requirements. *IEEE 1584 – Guide for Performing Arc Flash Hazards Calculations* provides suggested calculation methods.
9.6.4 Consideration should be given for means to lower the hazard level and applied where the arc flash hazard analysis at a designated piece of equipment is higher than is considered electrically safe for the PPE available.
9.6.5 Typically, the results from arc flash hazard analysis studies conducted system wide are field marked by a label on the equipment as well as the report retained by maintenance management to reference and use as needed.
9.6.6 The arc flash hazard analysis should be repeated if there are changes that occur that affect the arc flash hazard, such as changes in the available short-circuit current or in the overcurrent protective devices.
Substantiation: OSHA requires that electrical workers be protected from the hazards of the job and that a written hazard analysis be performed. An arc flash hazard is one of such hazards that need to be analyzed before performing electrical maintenance work.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-9 Log #4 EEM-AAA **Final Action: Accept in Principle in Part**
(9.9.4.1, 9.9.4.1.1, and 9.9.4.1.2)

Note: This proposal appeared as Comment 70B-9 (Log #20) which was held from the Fall 2009 ROC on Proposal 70B-26.
Submitter: Stephen McCluer, Rep. IEEE Stationary Battery Committee
Recommendation: Revise and combine 9.9.4.1 and 9.9.4.1.1. Delete 9.9.4.1.2
~~**9.9.4.1 General.** Stationary batteries are a primary power source for critical systems, ac power generation equipment, switchgear, and control circuits. Stationary batteries also provide backup power for essential equipment during outages of the primary power supply. Because these applications require reliable service, stationary batteries should be serviced regularly. The maintenance required depends on each battery's application, type, construction features and materials, and environment.~~
~~9.9.4.1.1 Lead–acid batteries are of two technologies: flooded wet cell design and sealed valve regulated lead–acid (VRLA) designs. Stationary batteries are typically lead–acid batteries with lead–antimony or lead–calcium grids. Some stationary batteries are nickel–cadmium (Ni-Cad) units. VRLA batteries have a shorter service life than flooded cells, cannot be tested in the same manner, and are not addressed in this document.~~
~~Battery chargers play a critical role in battery maintenance because they supply normal dc requirements and maintain batteries at appropriate levels of charge. Chargers should be set and maintained according to manufacturers' instructions.~~
General. Stationary batteries are most often used as the reserve power source for critical equipment during power outages. These batteries are typically vented lead-acid (VLA) batteries consisting of either lead calcium or lead-antimony grids. Other technologies may be utilized in these applications but are not specifically addressed in the following paragraphs. Due to the reliability requirements for these applications, specific safety guidelines as well as well defined maintenance practices should be utilized to ensure a reliable system. The following sections offer guidance on the safety and maintenance requirements. In addition, the manufacturers' recommendations should be followed and the appropriate IEEE standards referenced for additional information.
Substantiation: In their edit of 9.9.4, we would like to have seen the 70B committee's proposal combine paragraphs 9.9.4.1 and 9.9.4.1.1. The existing "General" paragraph does not summarize the intent of Section 9.9.4. It mentions things that are not actually discussed later. Paragraph 9.9.4.1.2 can be deleted as it is commentary and adds no guidance for procedures. Chargers should be beyond the scope of para 9.9.4., which is actually about batteries with only the briefest mention of chargers. Almost all batteries used in substation and switchgear applications are lead-acid, with an occasional VRLA or Ni-Cd (described as "other technologies" in this comment). Many of the subsequent paragraphs in the 2006 and the proposed 2010 editions address only vented lead-acid batteries.
This comment is the consensus of the IEEE Stationary Battery Code Working Group which includes the following members:
Phylis Archer/ C&D Technologies; Curtis Ashton/ Qwest Communications; Gary Balash/ Deka Batteries; Thomas Carpenter/ Arnold AFB; Allen Byrne / International Batteries; Daniel Levin / NYPA; Stephen McCluer/APC by Schneider Electric; Russell Miller/ Douglas Battery; John Polenz/ Emerson Electric; and Chris Searles/ BAE Batteries.
Committee Meeting Action: Accept in Principle in Part
Committee Statement: Refer to the committee action and statement on Proposal 70B-43 (Log 42).
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-10 Log #5 EEM-AAA **Final Action: Accept in Part**
(9.9.4.2)

Note: This proposal appeared as Comment 70B-11 (Log #21) which was held from the Fall 2009 ROC on Proposal 70B-26.
Submitter: Stephen McCluer, Rep. IEEE Stationary Battery Committee
Recommendation: Revise text to read as follows:
Maintenance Program. Battery maintenance normally consists of periodic inspections and tests. As a minimum, a maintenance program should be established based on manufacturers' installation & operation manuals. Ideally, other standards such as IEEE recommended practices applicable to the battery design may also be consulted, as these are frequently called out in the manufacturer's manuals. For further information on testing see 21.14, *Battery Testing*. ~~Visual inspections include checking electrolyte level and internal conditions in jar-type cells. Many battery problems can be detected by visual inspections. Tests aid in evaluating performance and permit comparisons with standards and with historical test results. Battery manufacturers are good sources of information for maintenance programs.~~
Substantiation: Delete the last 4 sentences of 9.9.4.2 as they do not give any specifics about what visual inspection should look for on any given type of battery or how to interpret what is observed. Procedures will vary from one battery technology to another. Detailed procedures are provided by the battery manufacturers and/or standards written specifically for the type of battery. IEEE standards are the most commonly referenced standards for stationary battery installation and maintenance.
This comment is the consensus of the IEEE Stationary Battery Code Working Group which includes the following members:
Phylis Archer/ C&D Technologies; Curtis Ashton/ Qwest Communications; Gary Balash/ Deka Batteries; Thomas Carpenter/ Arnold AFB; Allen Byrne / International Batteries; Daniel Levin / NYPA; Stephen McCluer/APC by Schneider Electric; Russell Miller/ Douglas Battery; John Polenz/ Emerson Electric; and Chris Searles/ BAE Batteries.
Committee Meeting Action: Accept in Part
Committee Statement: Refer to the committee action and statement on Proposal 70B-45 (Log 44).
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-11 Log #6 EEM-AAA **Final Action: Accept**
(9.9.4.3)

Note: This proposal appeared as Comment 70B-13 (Log #22) which was held from the Fall 2009 ROC on Proposal 70B-26.
Submitter: Stephen McCluer, Rep. IEEE Stationary Battery Committee
Recommendation: Revise text to read as follows:
Safety Guidelines. Personnel should be aware of the hazards associated with stationary batteries. ~~A battery can produce and emit a mixture of hydrogen and oxygen gas that is explosive~~. A vented battery emits a mixture of hydrogen and oxygen gas. Under abnormal conditions, such as a lack of space ventilation, it is possible for the mixture to reach a flammable level. Exposing skin and eyes to electrolyte can cause severe burns and blindness. Voltages present can cause injury and death. As a minimum, the safety precautions in 9.9.4.3.1 through 9.9.4.3.7 should be observed**.**
Substantiation: The existing language of 9.9.4.3 exaggerates the hazards. A vented battery that is properly installed, maintained, and operated in a properly ventilated space will not create explosive levels of gas. It is only under abnormal conditions that such a condition can occur.
This comment is the consensus of the IEEE Stationary Battery Code Working Group which includes the following members: Phylis Archer/ C&D Technologies; Curtis Ashton/ Qwest Communications; Gary Balash/ Deka Batteries; Thomas Carpenter/ Arnold AFB ; Allen Byrne / International Batteries ; Daniel Levin / NYPA; Stephen McCluer/APC by Schneider Electric; Russell Miller/ Douglas Battery; John Polenz/ Emerson Electric; and Chris Searles/ BAE Batteries.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-12 Log #7 EEM-AAA **Final Action: Reject**
(9.9.4.3.1)

Note: This proposal appeared as Comment 70B-15 (Log #23) which was held from the Fall 2009 ROC on Proposal 70B-26.
Submitter: Stephen McCluer, Rep. IEEE Stationary Battery Committee
Recommendation: Revise text to read as follows:
Maintenance personnel should be trained to perform the tasks properly ~~. Training should include using personal protective equipment, handling the electrolyte safely, using the proper tools, and~~ following the battery manufacturer's service and maintenance instructions and recommended tools.
Substantiation: This list in 9.9.4.3.1 is not all-inclusive. Refer to the manufacturer's instructions for the skills required for a specific battery technology, and which frequently refer to other standards such as IEEE battery standards and NFPA 70E. The latter go into more detail about the levels and types of skills required. IEEE draft Standard 1657, which will be published prior to the next edition of NFPA 70B, gives detailed curriculum for certifying battery technicians.
This comment is the consensus of the IEEE Stationary Battery Code Working Group which includes the following members: Phylis Archer/ C&D Technologies; Curtis Ashton/ Qwest Communications; Gary Balash/ Deka Batteries ; Thomas Carpenter/ Arnold AFB; Allen Byrne / International Batteries; Daniel Levin / NYPA; Stephen McCluer/APC by Schneider Electric; Russell Miller/ Douglas Battery; John Polenz/ Emerson Electric; and Chris Searles/ BAE Batteries.
Committee Meeting Action: Reject
Committee Statement: Refer to the committee action and statement on Proposal 70B-47 (Log 46).
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-13 Log #8 EEM-AAA **Final Action: Reject**
(9.9.4.3.2)

Note: This proposal appeared as Comment 70B-16 (Log #24) which was held from the Fall 2009 ROC on Proposal 70B-26.
Submitter: Stephen McCluer, Rep. IEEE Stationary Battery Committee
Recommendation: Delete the following text:
~~The room or compartment in which operating lead–acid batteries are located should be ventilated adequately.~~
Substantiation: Delete 9.9.4.3.2
This is a design issue, not a maintenance issue.
This comment is the consensus of the IEEE Stationary Battery Code Working Group which includes the following members: Phylis Archer/ C&D Technologies; Curtis Ashton/ Qwest Communications; Gary Balash/ Deka Batteries; Thomas Carpenter/ Arnold AFB; Allen Byrne / International Batteries; Daniel Levin / NYPA; Stephen McCluer/APC by Schneider Electric; Russell Miller/ Douglas Battery; John Polenz/ Emerson Electric; and Chris Searles/ BAE Batteries.
Committee Meeting Action: Reject
Committee Statement: Refer to the committee action and statement on Proposal 70B-48 (Log 47).
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-14 Log #9 EEM-AAA **Final Action: Accept**
(9.9.4.3.3)

Note: This proposal appeared as Comment 70B-18 (Log #25) which was held from the Fall 2009 ROC on Proposal 70B-26.
Submitter: Stephen McCluer, Rep. IEEE Stationary Battery Committee
Recommendation: Revise text to read as follows:
Appropriate safety equipment should be ~~worn~~ used in accordance with NFPA 70E and manufacturer's instructions. ~~, including goggles, gloves, and aprons, by persons working with the batteries. Eyewash and quick drench facilities should be provided near the batteries.~~
Substantiation: NFPA 70E and battery manufacturers specify the safety equipment and tools for battery installation and maintenance. Provision for eye wash stations is a design issue, not a maintenance function. NFPA 70E (240.2) requires installation and proper functioning of eye wash equipment.
This comments is the consensus of the IEEE Stationary Battery Code Working Group which includes the following members: Phylis Archer/ C&D Technologies; Curtis Ashton/ Qwest Communications; Gary Balash/ Deka Batteries; Thomas Carpenter/ Arnold AFB; Allen Byrne / International Batteries; Daniel Levin / NYPA; Stephen McCluer/APC by Schneider Electric; Russell Miller/ Douglas Battery; John Polenz/ Emerson Electric; and Chris Searles/ BAE Batteries.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-15 Log #10 EEM-AAA **Final Action: Accept**
(9.9.4.3.4)

Note: This proposal appeared as Comment 70B-20 (Log #26) which was held from the Fall 2009 ROC on Proposal 70B-26.
Submitter: Stephen McCluer, Rep. IEEE Stationary Battery Committee
Recommendation: Revise text to read as follows:
Open flames, sparks, ~~hot plates,~~ and other ignition sources should be kept away from storage batteries, gas ventilation paths, and places where hydrogen can accumulate.
Substantiation: Delete "hot plates" as it is not necessary and typically would not be in a battery room in the first place. A hot plate would qualify as just one example of many "other ignition sources."
This comment is the consensus of the IEEE Stationary Battery Code Working Group which includes the following members: Phylis Archer/ C&D Technologies; Curtis Ashton/ Qwest Communications; Gary Balash/ Deka Batteries; Thomas Carpenter/ Arnold AFB; Allen Byrne / International Batteries; Daniel Levin / NYPA; Stephen McCluer/APC by Schneider Electric; Russell Miller/ Douglas Battery; John Polenz/ Emerson Electric; and Chris Searles/ BAE Batteries.
Committee Meeting Action: Accept
Committee Statement: The committee notes that this is section 15.9.4.3.4.
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-16 Log #11 EEM-AAA **Final Action: Accept**
(9.9.4.3.5)

Note: This proposal appeared as Comment 70B-22 (Log #27) which was held from the Fall 2009 ROC on Proposal 70B-26.
Submitter: Stephen McCluer, Rep. IEEE Stationary Battery Committee
Recommendation: Revise text to read as follows:
~~Metal~~ Conductive objects should not be ~~placed on~~ used near battery cells. Insulated tools should be used to protect against shorting of cells.
Substantiation: 9.9.4.3.5 could be deleted entirely as it would be addressed in 9.9.4.3.1. Replace "metal" with "conductive," as objects can be conductive but not necessarily metal. Conductive objects should not be placed on or used near the conductive elements of a battery system.
This comment is the consensus of the IEEE Stationary Battery Code Working Group which includes the following members: Phylis Archer/ C&D Technologies; Curtis Ashton/ Qwest Communications; Gary Balash/ Deka Batteries; Thomas Carpenter/ Arnold AFB; Allen Byrne / International Batteries; Daniel Levin / NYPA; Stephen McCluer/APC by Schneider Electric; Russell Miller/ Douglas Battery; John Polenz/ Emerson Electric; and Chris Searles/ BAE Batteries.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-17 Log #12 EEM-AAA **Final Action: Accept**
(9.9.4.3.6)

Note: This proposal appeared as Comment 70B-24 (Log #28) which was held from the Fall 2009 ROC on Proposal 70B-26.
Submitter: Stephen McCluer, Rep. IEEE Stationary Battery Committee
Recommendation: Delete the following text:
~~When electrolyte is being prepared, personal protective equipment should include a full face shield. POUR ACID INTO WATER, NOT WATER INTO ACID. If the electrolyte comes in contact with skin or eyes, the affected area should be immediately flushed with water and medical assistance obtained~~
Substantiation: Delete this paragraph. Mixing acid and water in the field is not a standard practices (is really the rare exception). Most often we just add water to a cell. When electrolyte is required, it is almost always obtained from the manufacturer in the proper specific gravity.
This comment is the consensus of the IEEE Stationary Battery Code Working Group which includes the following members: Phylis Archer/ C&D Technologies; Curtis Ashton/ Qwest Communications; Gary Balash/ Deka Batteries; Thomas Carpenter/ Arnold AFB; Allen Byrne / International Batteries; Daniel Levin / NYPA; Stephen McCluer/APC by Schneider Electric; Russell Miller/ Douglas Battery; John Polenz/ Emerson Electric; and Chris Searles/ BAE Batteries.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-18 Log #13 EEM-AAA **Final Action: Accept**
(9.9.4.3.7)

Note: This proposal appeared as Comment 70B-26 (Log #29) which was held from the Fall 2009 ROC on Proposal 70B-26.
Submitter: Stephen McCluer, Rep. IEEE Stationary Battery Committee
Recommendation: Revise text to read as follows:
Unauthorized access to ~~the battery area~~ <u>exposed batteries</u> should be prohibited.
Substantiation: This is only applicable when the batteries are located in a battery room or other restricted area in which batteries are installed in open racks. Often batteries are collocated with other equipment where access is required by several technical and operating personnel, in which case batteries are typically secured in cabinets. In these cases, appropriate warning signs should be displayed.
This comment is the consensus of the IEEE Stationary Battery Code Working Group which includes the following members: Phylis Archer/ C&D Technologies; Curtis Ashton/ Qwest Communications; Gary Balash/ Deka Batteries; Thomas Carpenter/ Arnold AFB; Allen Byrne / International Batteries; Daniel Levin / NYPA; Stephen McCluer/APC by Schneider Electric; Russell Miller/ Douglas Battery, John Polenz/ Emerson Electric; and Chris Searles/ BAE Batteries.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-19 Log #14 EEM-AAA **Final Action: Accept**
(9.9.4.4)

Note: This proposal appeared as Comment 70B-27 (Log #30) which was held from the Fall 2009 ROC on Proposal 70B-26.
Submitter: Stephen McCluer, Rep. IEEE Stationary Battery Committee
Recommendation: Revise text to read as follows:
Guide for Visual, <u>Mechanical and Electrical</u> Inspections ~~and Associated Servicing.~~
Substantiation: Reword the title of paragraph 9.9.4.4. to clarify that it is for visual inspections only, of both mechanical and electrical equipment. Delete "associated servicing" as this is included in other paragraphs.
This comment is the consensus of the IEEE Stationary Battery Code Working Group which includes the following members: Phylis Archer/ C&D Technologies; Curtis Ashton/ Qwest Communications; Gary Balash/ Deka Batteries ; Thomas Carpenter/ Arnold AFB ; Allen Byrne / International Batteries; Daniel Levin / NYPA; Stephen McCluer/APC by Schneider Electric; Russell Miller/ Douglas Battery; John Polenz/ Emerson Electric; and Chris Searles/ BAE Batteries.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-20 Log #15 EEM-AAA **Final Action: Accept**
(9.9.4.4.1)

Note: This proposal appeared as Comment 70B-28 (Log #31) which was held from the Fall 2009 ROC on Proposal 70B-26.
Submitter: Stephen McCluer, Rep. IEEE Stationary Battery Committee
Recommendation: Revise text to read as follows:
~~Jars~~ <u>Containers</u> and covers should be checked for cracks and structural damage. ~~Maintenance of flame arrester-type vent caps should consist of rinsing them in clear water and air drying~~. Damaged units and <u>damaged or missing removable</u> vent caps should be replaced.
Substantiation: The slang term "jars" is technically incorrect; the term "container" should be substituted wherever the term "jars" is used in this document.
Cleaning of flame arrestors is not a standard battery maintenance routine and is not recommended as it can introduce contaminants into the electrolyte, it can create a potentially hazardous condition if flame arrestors are removed more than briefly, and flame arrestor vent caps cannot be serviced on VRLA or similar batteries. Damaged or missing vent caps should be replaced.
This comment is the consensus of the IEEE Stationary Battery Code Working Group which includes the following members: Phylis Archer/ C&D Technologies; Curtis Ashton/ Qwest Communications; Gary Balash/ Deka Batteries ; Thomas Carpenter/ Arnold AFB; Allen Byrne / International Batteries ; Daniel Levin / NYPA; Stephen McCluer/APC by Schneider Electric; Russell Miller/ Douglas Battery; John Polenz/ Emerson Electric; and Chris Searles/ BAE Batteries.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-21 Log #16 EEM-AAA **Final Action: Accept in Principle**
(9.9.4.4.2)

Note: This proposal appeared as Comment 70B-29 (Log #32) which was held from the Fall 2009 ROC on Proposal 70B-26.
Submitter: Stephen McCluer, Rep. IEEE Stationary Battery Committee
Recommendation: Revise text to read as follows:
Plates <u>and internal parts</u> ~~of~~ <u>within</u> clear ~~jars~~ <u>containers</u> should be checked <u>for damages such as</u> buckling, warping, scaling, swelling, cracking, <u>hydration rings, excessive sedimentation, mossing, copper contamination, internal post seal cracks,</u> and changes in color. ~~Damaged~~ <u>Questionable</u> cells should be ~~replaced~~ evaluated for repair or replacement.
Substantiation: The term "jars" is technically incorrect; the term "container" should be used wherever the term "jars" is used in this document. Internal parts should also be checked for a lot more than what is presently identified. Sometimes minor damage can be repaired. Some degree of battery defect can be tolerated or repaired.
This comment is the consensus of the IEEE Stationary Battery Code Working Group which includes the following members: Phylis Archer/ C&D Technologies Inc.; Curtis Ashton/ Qwest Communications; Gary Balash/ East Penn Mfg; Thomas Carpenter/ Aerospace Testing Alliance; Allen Byrne / International Batteries ; Daniel Levin / NYPA; Stephen McCluer/APC by Schneider Electric; Russell Miller/ Douglas Battery; John Polenz/ Emerson Network Power; Chris Searles/ BAE Batteries; Dan McMenamin/DMA; Ron Marts/Telcordia; Russell Miller/ Douglas Battery; John Polenz/ Emerson Network Equipment; and Chris Searles/ BAE Batteries.
Committee Meeting Action: Accept in Principle
Committee Statement: Refer to the committee action and statement on Proposal 70B-55 (Log 70).
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-22 Log #17 EEM-AAA **Final Action: Accept**
(9.9.4.4.3)

Note: This proposal appeared as Comment 70B-30 (Log #33) which was held from the Fall 2009 ROC on Proposal 70B-26.
Submitter: Stephen McCluer, Rep. IEEE Stationary Battery Committee
Recommendation: Revise text to read as follows:
~~The charger should be checked for proper operation.~~ Interconnection cables, cell connectors, and other conductors should be examined for wear, contamination, corrosion, and discoloration. Racks should be checked for corrosion, cleanliness, <u>proper grounding,</u> and structural integrity.
Substantiation: Chargers should be removed from this section of the document (see previous proposal on para 9.9..4) Grounding can also be affected by the same issues cited in the previous sentence.
This comment is the consensus of the IEEE Stationary Battery Code Working Group which includes the following members: Phylis Archer/ C&D Technologies Inc.; Curtis Ashton/ Qwest Communications; Gary Balash/ East Penn Mfg; Thomas Carpenter/ Aerospace Testing Alliance ; Allen Byrne / International Batteries ; Daniel Levin / NYPA; Stephen McCluer/APC by Schneider Electric; Russell Miller/ Douglas Battery; John Polenz/ Emerson Network Power; Chris Searles/ BAE Batteries; Dan McMenamin/DMA; Ron Marts/Telcordia; Russell Miller/ Douglas Battery; John Polenz/ Emerson Network Equipment; and Chris Searles/ BAE Batteries.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-23 Log #18 EEM-AAA **Final Action: Accept**
(9.9.4.4.4)

Note: This proposal appeared as Comment 70B-31 (Log #34) which was held from the Fall 2009 ROC on Proposal 70B-26.
Submitter: Stephen McCluer, Rep. IEEE Stationary Battery Committee
Recommendation: Revise text to read as follows:
A check should be made for spilled electrolyte. A solution of water and bicarbonate of soda (baking soda) ~~solution~~ should be used to neutralize lead–acid battery spills, and a boric acid and water solution should be used for Ni-Cad spills in accordance with the battery manufacturer's instructions.
Substantiation: Battery manufacturer's would indicate the proper solution and dilution.
This comment is the consensus of the IEEE Stationary Battery Code Working Group which includes the following members: Phylis Archer/ C&D Technologies Inc.; Curtis Ashton/ Qwest Communications; Gary Balash/ East Penn Mfg; Thomas Carpenter/ Aerospace Testing Alliance ; Allen Byrne / International Batteries ; Daniel Levin / NYPA; Stephen McCluer/APC by Schneider Electric; Russell Miller/ Douglas Battery; John Polenz/ Emerson Network Power; Dan McMenamin/DMA; Ron Marts/Telcordia; Russell Miller/ Douglas Battery; John Polenz/ Emerson Network Equipment; and Chris Searles/ BAE Batteries.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-24 Log #19 EEM-AAA **Final Action: Accept**
(9.9.4.4.5)

Note: This proposal appeared as Comment 70B-32 (Log #35) which was held from the Fall 2009 ROC on Proposal 70B-26.
Submitter: Stephen McCluer, Rep. IEEE Stationary Battery Committee
Recommendation: Revise text to read as follows:
The electrolyte level before water addition, should be checked and corrective measures should be noted in accordance with the owner's maintenance program and the manufacturer's recommendations. ~~It should be determined that electrolyte and cells are clear, with minimal deposits, gassing, or rings, and that there is only minor sediment below the plates. The amounts of water added to the cells should be recorded.~~ Excessive water consumption can be a sign of overcharging or cell damage. For lead–antimony batteries, water consumption increases gradually with age. Distilled or deionized water should be used unless otherwise recommended by the battery manufacturer.
CAUTION: Never add ~~acid~~ anything but water to a battery ~~when refilling.~~ unless recommended to do so by the manufacturer.
Substantiation: It is assumed that there is already a maintenance program established to address inspection and recording of electrolyte levels.
The items in the second sentence are already addressed in previous paragraphs (see 9.9.4.4.2)
The 3rd sentence is already addressed w/ revisions to the 1st sentence.
re: 4th sentence: Partial cell shorts can cause excessive water consumption.
In large battery installations it can often be less expensive to install deionization equipment than to buy distilled water for battery watering. Properly maintained deionization equipment can and does provide perfectly suitable water for batteries.
re Caution: delete the words "when refilling" as they are not needed. Acid, electrolyte, or anything else should not be added unless specifically instructed to do so by the manufacturer.
This comment is the consensus of the IEEE Stationary Battery Code Working Group which includes the following members: Phylis Archer/ C&D Technologies Inc.; Curtis Ashton/ Qwest Communications; Gary Balash/ East Penn Mfg; Thomas Carpenter/ Aerospace Testing Alliance ; Allen Byrne / International Batteries ; Daniel Levin / NYPA; Stephen McCluer/APC by Schneider Electric; Russell Miller/ Douglas Battery; John Polenz/ Emerson Network Power; Dan McMenamin/DMA; Ron Marts/Telcordia; Russell Miller/ Douglas Battery; John Polenz/ Emerson Network Equipment; and Chris Searles/ BAE Batteries.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-25 Log #20 EEM-AAA **Final Action: Accept**
(9.9.4.4.6)

Note: This proposal appeared as Comment 70B-33 (Log #36) which was held from the Fall 2009 ROC on Proposal 70B-26.
Submitter: Stephen McCluer, Rep. IEEE Stationary Battery Committee
Recommendation: Revise text to read as follows:
Ventilation and the suitability and condition of electrical equipment in the area should be checked for its possible effect on the battery. ~~Battery proximity to combustibles and ignition sources should be evaluated.~~ Local sources of heating and cooling can create cell temperature differentials that cause battery damage. Battery room vVentilation openings should be checked to be sure they are clear of obstructions.
Substantiation: Both heating and cooling - or lack thereof - can affect battery performance.
The 2nd sentence is addressed in para 9.9.4.3. 4
Add the final sentence, which is moved from 9.9.4.4.13 because it fits better here.
Note: Most of this paragraph addresses installation issues more than maintenance issues.
This comment is the consensus of the IEEE Stationary Battery Code Working Group which includes the following members: Phylis Archer/ C&D Technologies Inc.; Curtis Ashton/ Qwest Communications; Gary Balash/ East Penn Mfg; Thomas Carpenter/ Aerospace Testing Alliance; Allen Byrne / International Batteries; Daniel Levin / NYPA; Stephen McCluer/APC by Schneider Electric; Russell Miller/ Douglas Battery; John Polenz/ Emerson Network Power; Dan McMenamin/DMA; Ron Marts/Telcordia; Russell Miller/ Douglas Battery; John Polenz/ Emerson Network Equipment; and Chris Searles/ BAE Batteries.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-26 Log #21 EEM-AAA **Final Action: Accept**
(9.9.4.4.7)

Note: This proposal appeared as Comment 70B-34 (Log #37) which was held from the Fall 2009 ROC on Proposal 70B-26.
Submitter: Stephen McCluer, Rep. IEEE Stationary Battery Committee
Recommendation: Revise text to read as follows:
Ambient temperature should be checked to be within the manufacturer's recommended range. For example, ~~the optimum ambient operating temperature for lead–acid batteries is~~ 20-~~25°C (~~68 - ~~77°F). Ni-Cad batteries can operate satisfactorily over a~~ greater ~~range of temperatures, generally from 25°C to 45°C (77~~ 41 ~~°F to 113°F~~). High ambient temperatures reduce cell life. ~~Every 9~~ 8.4~~°C (15°F) increase in temperature above 25°C (77°F) can reduces lead–acid cell life by up to 50 percent and Ni-Cad cell life by up to 20 percent~~. Lower ambient cell temperatures reduce cell capacity (~~A lead-acid battery operating at 16°C (60°F) loses about 10 percent of its designed capacity.~~
Substantiation: Most of the statements made in 9.9.4.4.7 are design issues, not maintenance issues. The values cited can vary from one manufacturer to another depending upon many variables. The technician should make sure that ambient temperature is within the range specified by the battery manufacturer.
This comment is the consensus of the IEEE Stationary Battery Code Working Group which includes the following members: Phylis Archer/ C&D Technologies Inc.; Curtis Ashton/ Qwest Communications; Gary Balash/ East Penn Mfg; Thomas Carpenter/ Aerospace Testing Alliance; Allen Byrne / International Batteries; Daniel Levin / NYPA; Stephen McCluer/APC by Schneider Electric; Russell Miller/ Douglas Battery; John Polenz/ Emerson Network Power; Dan McMenamin/DMA; Ron Marts/Telcordia; Russell Miller/ Douglas Battery; John Polenz/ Emerson Network Equipment; and Chris Searles/ BAE Batteries.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-27 Log #22 EEM-AAA **Final Action: Accept**
(9.9.4.4.9 (New))

Note: This proposal appeared as Comment 70B-36 (Log #39) which was held from the Fall 2009 ROC on Proposal 70B-26.
Submitter: Stephen McCluer, Rep. IEEE Stationary Battery Committee
Recommendation: Insert a new 9.9.4.4.9 and renumber all subsequent paragraphs.
Verify that voltage potential between the battery's most positive and most negative terminals is within the manufacturer's recommended float voltage range for the observed ambient temperature.
Substantiation: High or low voltage can be a sign of charger failure, improper setting, charger malfunction, or excessive voltage drop in the wiring. This paragraph addresses charger issues.
This comment is the consensus of the IEEE Stationary Battery Code Working Group which includes the following members: Phylis Archer/ C&D Technologies Inc.; Curtis Ashton/ Qwest Communications; Gary Balash/ East Penn Mfg; Thomas Carpenter/ Aerospace Testing Alliance; Allen Byrne / International Batteries; Daniel Levin / NYPA; Stephen McCluer/APC by Schneider Electric; Russell Miller/ Douglas Battery; John Polenz/ Emerson Network Power; Dan McMenamin/DMA; Ron Marts/Telcordia; Russell Miller/ Douglas Battery; John Polenz/ Emerson Network Equipment; and Chris Searles/ BAE Batteries.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-28 Log #23 EEM-AAA **Final Action: Accept in Part**
(9.9.4.4.10 [formerly 9.9.4.5.2])

Note: This proposal appeared as Comment 70B-37 (Log #40) which was held from the Fall 2009 ROC on Proposal 70B-26.
Submitter: Stephen McCluer, Rep. IEEE Stationary Battery Committee
Recommendation: Revise text to read as follows:
Lead–acid battery surfaces should be cleaned with a mild solution of water and sodium bicarbonate to avoid leakage currents caused by electrolyte on the battery. Ni-Cad battery surfaces should be cleaned with a solution of boric acid and water. ~~solution~~. Cleaners, soaps, or solvents should not be used to clean battery containers ~~jars~~ and covers, since damage can result. Consult the battery manufacturer for the proper solution and dilution.
Substantiation: Battery manufacturer's would indicate the proper solution and dilution.
This comment is the consensus of the IEEE Stationary Battery Code Working Group which includes the following members: Phylis Archer/ C&D Technologies Inc.; Curtis Ashton/ Qwest Communications; Gary Balash/ East Penn Mfg; Thomas Carpenter/ Aerospace Testing Alliance; Allen Byrne / International Batteries; Daniel Levin / NYPA; Stephen McCluer/APC by Schneider Electric; Russell Miller/ Douglas Battery; John Polenz/ Emerson Network Power; Dan McMenamin/DMA; Ron Marts/Telcordia; Russell Miller/ Douglas Battery; John Polenz/ Emerson Network Equipment; and Chris Searles/ BAE Batteries.
Committee Meeting Action: Accept in Part
Committee Statement: Refer to the committee action and statement on Proposal 70B-63 (Log 59).
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-29 Log #24 EEM-AAA **Final Action: Accept in Principle**
(9.9.4.4.11 [formerly 9.9.4.5.3])

Note: This proposal appeared as Comment 70B-38 (Log #41) which was held from the Fall 2009 ROC on Proposal 70B-26.
Submitter: Stephen McCluer, Rep. IEEE Stationary Battery Committee
Recommendation: Revise text to read as follows:
~~The intercell connectors (links) should be checked annually and torqued to specified values.~~
All battery connections should be checked on a routine basis for high connection resistance. When a connection resistance is high then the connections should be cleaned and re-torqued in accordance with the manufacturer's procedures.
Substantiation: Many manufacturers no longer recommend to re-torque annually as this practice leads to deformation and over-stressing of the posts. Furthermore, it does not guarantee a good connection.
This comment is the consensus of the IEEE Stationary Battery Code Working Group which includes the following members: Phylis Archer/ C&D Technologies Inc.; Curtis Ashton/ Qwest Communications; Gary Balash/ East Penn Mfg; Thomas Carpenter/ Aerospace Testing Alliance; Allen Byrne / International Batteries; Daniel Levin / NYPA; Stephen McCluer/APC by Schneider Electric; Russell Miller/ Douglas Battery; John Polenz/ Emerson Network Power; Dan McMenamin/DMA; Ron Marts/Telcordia; Russell Miller/ Douglas Battery; John Polenz/ Emerson Network Equipment; and Chris Searles/ BAE Batteries.
Committee Meeting Action: Accept in Principle
Committee Statement: Refer to the committee action and statement on Proposal 70B-64 (Log 60).
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-30 Log #25 EEM-AAA **Final Action: Accept**
(9.9.4.4.13 [formerly 9.9.4.5.5])

Note: This proposal appeared as Comment 70B-40 (Log #43) which was held from the Fall 2009 ROC on Proposal 70B-26.
Submitter: Stephen McCluer, Rep. IEEE Stationary Battery Committee
Recommendation: Delete text as follows:
~~9.9.4.4.13 Battery room vVentilation openings should be checked to be sure they are clear of obstructions.~~
Substantiation: Delete this paragraph and move the statement to 9.9.4.4.6 where ventilation is addressed.
This comment is the consensus of the IEEE Stationary Battery Code Working Group which includes the following members: Phylis Archer/ C&D Technologies Inc; Curtis Ashton/ Qwest Communications; Gary Balash/ East Penn Mfg; Thomas Carpenter/ Aerospace Testing Alliance; Allen Byrne / International Batteries; Daniel Levin / NYPA; Stephen McCluer/APC by Schneider Electric; Russell Miller/ Douglas Battery; John Polenz/ Emerson Network Power; Dan McMenamin/DMA; Ron Marts/Telcordia; Russell Miller/ Douglas Battery; John Polenz/ Emerson Network Equipment; and Chris Searles/ BAE Batteries.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-31 Log #26 EEM-AAA **Final Action: Accept**
(9.9.4.5.1 [formerly 9.9.4.6.1])

Note: This proposal appeared as Comment 70B-41 (Log #44) which was held from the Fall 2009 ROC on Proposal 70B-26.
Submitter: Stephen McCluer, Rep. IEEE Stationary Battery Committee
Recommendation: Delete the following text:
~~9.9.4.5.1 Excessive gassing can result from overcharging.~~
Substantiation: Delete paragraph 9.9.4.5.1. It is addressed in 9.9.4.3.
This comment is the consensus of the IEEE Stationary Battery Code Working Group which includes the following members: Phylis Archer/ C&D Technologies Inc.; Curtis Ashton/ Qwest Communications; Gary Balash/ East Penn Mfg; Thomas Carpenter/ Aerospace Testing Alliance; Allen Byrne / International Batteries; Daniel Levin / NYPA; Stephen McCluer/APC by Schneider Electric; Russell Miller/ Douglas Battery; John Polenz/ Emerson Network Power; Dan McMenamin/DMA; Ron Marts/Telcordia; Russell Miller/ Douglas Battery; John Polenz/ Emerson Network Equipment; and Chris Searles/ BAE Batteries.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-32 Log #27 EEM-AAA **Final Action: Reject**
(9.9.4.5.2 [formerly 9.9.4.6.2])

Note: This proposal appeared as Comment 70B-42 (Log #45) which was held from the Fall 2009 ROC on Proposal 70B-26.
Submitter: Stephen McCluer, Rep. IEEE Stationary Battery Committee
Recommendation: Delete the following text:
~~9.9.4.5.2 Vibration reduces battery life. Excessive vibration can be detected by observing vibration of plates and sediment in the jar.~~
Substantiation: Vibration does reduce life, but it is more likely to be a problem before it can be detected by visual observation. If construction next door or some other source of vibration causes excess sedimentation or plate cracking, there is not much that a maintenance technician can do about it.
This comment is the consensus of the IEEE Stationary Battery Code Working Group which includes the following members: Phylis Archer/ C&D Technologies Inc.; Curtis Ashton/ Qwest Communications; Gary Balash/ East Penn Mfg; Thomas Carpenter/ Aerospace Testing Alliance; Allen Byrne / International Batteries; Daniel Levin / NYPA; Stephen McCluer/APC by Schneider Electric; Russell Miller/ Douglas Battery; John Polenz/ Emerson Network Power; Dan McMenamin/DMA; Ron Marts/Telcordia; Russell Miller/ Douglas Battery; John Polenz/ Emerson Network Equipment; and Chris Searles/ BAE Batteries.
Committee Meeting Action: Reject
Committee Statement: Refer to the committee action and statement on Proposal 70B-68 (Log 64).
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-33 Log #28 EEM-AAA **Final Action: Accept**
(9.9.4.5.3 [formerly 9.9.4.6.3])

Note: This proposal appeared as Comment 70B-43 (Log #46) which was held from the Fall 2009 ROC on Proposal 70B-26.
Submitter: Stephen McCluer, Rep. IEEE Stationary Battery Committee
Recommendation: Delete the following text:
~~9.9.4.5.3 A lead–acid battery electrolyte begins to freeze at -29°C (-20°F), but it can freeze at warmer temperatures if its specific gravity is low. Once ice crystals form, damage to the cell is irreparable.~~
Substantiation: The statement in 9.9.4.5.3 adds no value, and the values stated are technically incorrect anyway because the freezing point is a function of the specific gravity of the battery electrolyte. If a battery is installed into an environment that is so far below the manufacturer's recommended operating temperature that it freezes, this is not a service issue but an application design issue. If the water in the battery freezes, the technician already knows he has a problem.
This comment is the consensus of the IEEE Stationary Battery Code Working Group which includes the following members: Phylis Archer/ C&D Technologies Inc.; Curtis Ashton/ Qwest Communications; Gary Balash/ East Penn Mfg; Thomas Carpenter/ Aerospace Testing Alliance; Allen Byrne / International Batteries; Daniel Levin / NYPA; Stephen McCluer/APC by Schneider Electric; Russell Miller/ Douglas Battery; John Polenz/ Emerson Network Power; Dan McMenamin/DMA; Ron Marts/Telcordia; Russell Miller/ Douglas Battery; John Polenz/ Emerson Network Equipment; and Chris Searles/ BAE Batteries.

Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-34 Log #29 EEM-AAA **Final Action: Accept**
(9.9.4.5.4 [formerly 9.9.4.6.4])

Note: This proposal appeared as Comment 70B-44 (Log #47) which was held from the Fall 2009 ROC on Proposal 70B-26.
Submitter: Stephen McCluer, Rep. IEEE Stationary Battery Committee
Recommendation: Delete the following text:
~~9.9.4.5.4 Hydration occurs when a lead-acid battery is overdischarged without an immediate recharge, or when a dry-charge battery is accidentally filled with water. A sign of hydration is a whitish ring in the jar, which eventually shorts the positive and negative plates. Hydration is an irreversible condition.~~
Substantiation: The statement in 9.9.4.5.4, while generally correct, is tutorial and give no guidance for corrective action. Inspection for hydration rings was covered previously in our proposal for 9.9.4.4.2

This comment is the consensus of the IEEE Stationary Battery Code Working Group which includes the following members: Phylis Archer/ C&D Technologies Inc.; Curtis Ashton/ Qwest Communications; Gary Balash/ East Penn Mfg; Thomas Carpenter/ Aerospace Testing Alliance; Allen Byrne / International Batteries; Daniel Levin / NYPA; Stephen McCluer/APC by Schneider Electric; Russell Miller/ Douglas Battery; John Polenz/ Emerson Network Power; Dan McMenamin/DMA; Ron Marts/Telcordia; Russell Miller/ Douglas Battery; John Polenz/ Emerson Network Equipment; and Chris Searles/ BAE Batteries.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-35 Log #30 EEM-AAA **Final Action: Accept**
(9.9.4.5.5 [formerly 9.9.4.6.5])

Note: This proposal appeared as Comment 70B-45 (Log #48) which was held from the Fall 2009 ROC on Proposal 70B-26.
Submitter: Stephen McCluer, Rep. IEEE Stationary Battery Committee
Recommendation: Delete the following text:
~~Overcharging of lead-acid cells or charging at excessive rates leads to mossing. Mossing is the development of sponge-like material high on the negative plates and the resulting sedimentation in the cells. Continued mossing shorts out the plates.~~
Substantiation: The statement in 9.9.4.5.5, while generally correct, is tutorial and gives no guidance for corrective action. Inspection for mossing was covered previously in our proposal for 9.9.4.4.2.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-35a Log #CP20 EEM-AAA **Final Action: Accept**
(11.2.1)

Submitter: Technical Committee on Electrical Equipment Maintenance,
Recommendation: Revise 11.2.1 as follows, including item numbering:
11.2.1 Acceptance Tests. Acceptance tests are tests that are performed on new equipment, ~~usually~~ at the factory, on-site and after installation, prior to energization. These tests determine whether a piece of equipment is in compliance with the purchase specification and design intent and also establish test benchmarks that can be used as references during future tests. ~~Acceptance tests are also valuable in ensuring that the equipment has not been damaged during shipment or installation. In addition to the tests that are performed, an acceptance program should include a comprehensive visual inspection and an operational check of all circuitry and accessory devices.~~
(1) Acceptance tests at the factory are valuable in ensuring the equipment was appropriately designed, manufactured and can be appropriately configured in the field to comply with the operational check to be performed in the field.
(2) Acceptance tests on-site are also valuable in ensuring that the equipment has not been damaged during shipment or installation. In addition to the tests that are performed, an acceptance program should include a comprehensive visual inspection and an operational check of all circuitry, accessory devices, and overall system.
Substantiation: Acceptance testing of electrical equipment and systems is performed in a number of steps from the equipment manufacturing floor through commissioning. NFPA 70B needs to recognize and acknowledge such acceptance testing for the user of the document to understand they can extract value is in the acceptance process in various stages even before it is completely installed and ready for commissioning.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-35b Log #CP21 EEM-AAA **Final Action: Accept**
(11.10.4)

Submitter: Technical Committee on Electrical Equipment Maintenance,
Recommendation: Revise text as follows, and re-number the subsections:
11.10.4 Field Testing of Circuit Breakers Employing Solid-State Trip~~s~~ Device.
11.10.4.1 Insulation Resistance Test. Insulation resistance tests are preformed to ensure acceptable insulation resistance between each phase conductor and ground. The equipment used to conduct these tests should be used to create an overvoltage to verify the insulation integrity. Review of the markings and instructional material for the circuit breaker should be done before conducting an insulation resistance test. It may be necessary to remove the rating plug or other connections before performing the test to prevent the trip system from being damaged.
11.10.4.2 Testing the Tripping System. Solid-state trip units are designed to operate on low-level currents obtained from the current transformers mounted on the phase conductors. Primary injection test sets will test the entire tripping system which validates the measurement functions and interconnectivity of sensing and trip devices. Secondary injection tests ~~sets are available from the manufacturer~~ validate the functionality of the trip unit and circuit breaker opening, however will not test the entire tripping system. Because these breakers have unique design characteristics, the manufacturers should be consulted for available test kits and testing instructions. *Attempted field repair of the solid-state trip units should be avoided*. Any suspected malfunction should be referred to a competent service group.
Substantiation: It is easy to damage a circuit breaker with solid state trip device if appropriate precautions are not taken before performing testing either on the breaker or the system that has this type of breakers installed on it. This new language will alert the person doing the test to take steps to prevent damaging the circuit breaker.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-35c Log #CP25 EEM-AAA **Final Action: Accept**
(Table 11.10.5.2.6)

Submitter: Technical Committee on Electrical Equipment Maintenance,
Recommendation: Replace Table 11.10.5.2.6 with replacement table derived from NEMA AB4, Table 4 as as shown on the following page.
And revise the last sentence of section 11.10.5.2.6 as follows:
In the absence of manufacturer's published tolerances, refer to Table 11.10.5.2 with values as recommended in ANSI/NEMA AB4,Guidelines for Inspection and Preventive Maintenance of Molded Case Circuit Breakers Used in Commercial and Industrial Applications,Table 4.
Substantiation: Revised table to include solid state adjustable trip devices.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-36 Log #38 EEM-AAA **Final Action: Accept**
(11.14.2.2)

Submitter: Steve McCluer, Schneider Electric / Rep. IEEE Stationary Battery Committee
Recommendation: Revise text to read as follows:
If used, pilot cell voltage specific gravity, and electrolyte temperature should be measured and recorded ~~monthly~~ per the established maintenance program (9.9.4.2). Refer to the manufacturer's recommended practices for the use of pilot cells and for the range for float voltage applicable to a specific battery. ~~Common float voltage range for lead-calcium cells is 2.20 volts to 2.30 volts per cell. Lead-antimony cells float at about 2.17 volts to 2.21 volts per cell. Ni-Cad cells charge at approximately 1.42 volts per cell. Manufacturers' literature should be referred to for specific charge potentials~~.
Substantiation: Pilot cell readings are optional and are primarily for lead-antimony batteries. Not all routines are monthly. There are three specific measurements mentioned in the statement. Only one has a range. The range given could be misleading depending upon the specific gravity. It would be better to refer to the manufacturer's recommendation for the specific battery.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

Table 11.10.5.2.6

INSTANTANEOUS TRIP TOLERANCES FOR FIELD TESTING OF CIRCUIT BREAKERS

Breaker Type	**Tolerances of Settings**	**Tolerances of Manufacturers' Published Trip Range**	
		High Side	**Low Side**
Electronic Trip Units[(1)]	+30% -30%	—	—
Adjustable [(1)]	+40% -30%	—	—
Non-adjustable[(2)]	—	+25%	-25%

[(1)] Tolerances are based on variations from the nominal settings.

[(2)] Tolerances are based on variations from the manufacturer's published trip band (i.e., -25% below the low side of the band; +25% above the high side of the band).

70B-37 Log #39 EEM-AAA **Final Action: Accept in Principle**
(11.14.2.3)

Submitter: Steve McCluer, Schneider Electric / Rep. IEEE Stationary Battery Committee
Recommendation: Revise text to read as follows:
A performance ~~load~~ test should be performed ~~within the first 2 years of installation and every 3 to 5 years thereafter~~ at intervals not greater than 25% of the expected service life, or as recommended by the manufacturer, depending on the load reliability requirements and environmental conditions of the installation. The frequency of battery tests should be increased to yearly when the battery reaches 85 percent of its service life or when it shows signs of deterioration.
Substantiation: The existing description is for a *performance* test, which is specific. See the definition in IEEE 450: "**performance test** – A constant current or constant power capacity test made on a battery after it has been in service, to detect any change in the capacity." A performance test tracks the capacity of the battery over time.
A *load* test, on the other hand, is a generic term that is not used by the IEEE stationary battery committee. A load test could be any type of test such as an "acceptance test" or an "as found test", and does not necessarily track changes over time.
IEEE 1188 (VRLA Battery maintenance) and 450 (Vented Lead-Acid Battery Maintenance) both recommend that performance test intervals should not be greater than 25% of the expected service life. IEEE 1106 recommends 5-year intervals.
Committee Meeting Action: Accept in Principle
Revise the text of the recommendation to read as follows:
A performance ~~load~~ test should be performed ~~within the first 2 years of installation and every 3 to 5 years thereafter~~ at intervals not greater than 25% of the expected service life as determined by the initial design, or as recommended by the manufacturer, depending on the load reliability requirements and environmental conditions of the installation. The frequency of battery tests should be increased to yearly when the battery reaches 85 percent of its service life or when it shows signs of deterioration.
Committee Statement: The committee add "as determined by the initial design" to provide additional information for the user.
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-38 Log #40 EEM-AAA **Final Action: Accept**
(11.14.2.5)

Submitter: Steve McCluer, Schneider Electric / Rep. IEEE Stationary Battery Committee
Recommendation: Revise text to read as follows:
11.14.2.5 Batteries should be examined under full load with an infrared scanning device whenever a performance test is conducted.. Infrared scanning can reveal problems such as ~~The~~ abnormal temperature of a cell, a poor connection at a battery post and a deteriorated link, strap, or conductor. ~~is some of the problems~~
Substantiation: Thermographic scans are becoming recognized as a "best practice" but have not been incorporated as a requirement under general maintenance or testing guidelines in battery maintenance standards**.**
A thermographic scan can be a useful tool, but only if properly conducted and analyzed. Technicians and data analysts must understand what is normal and what is abnormal.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-39 Log #41 EEM-AAA **Final Action: Accept**
(11.14.2.6)

Submitter: Steve McCluer, Schneider Electric / Rep. IEEE Stationary Battery Committee
Recommendation: Revise text to read as follows:
~~Test readings~~ Measurements should be recorded for future reference along with log notations of the visual inspection and corrective action. ~~A copy~~ An example of a battery record is included as Figure H.21. The record should be modified to correspond to the user's maintenance program per 15.9.4.2.
Substantiation: The example given in Figure H.21 is not applicable to all battery types. It is not applicable to capacity or performance testing. It applies to routine maintenance/ inspection and really should not be referenced in this testing section at all.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-39a Log #CP7 EEM-AAA **Final Action: Accept**
(11.21.1)

Submitter: Technical Committee on Electrical Equipment Maintenance,
Recommendation: Revise 11.21.1 to read as follows:
11.21.1 **Cable Field Testing In General**.
11.21.1.1 The applicable industry field evaluation standards for electrical power cables include the following:
(1) ANSI/NETA *Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems(ATS)*
(2) ANSI/NETA *Standard for Maintenance Testing Specifications for Electrical Power Distribution Equipment and Systems (MTS)*
(3) IEEE-400 *Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems*
(4) IEEE-400.1 *Guide for Field Testing of Laminated Dielectric, Shielded Power Cable Systems Rated 5kV and Above with High Direct Current Voltage*
(5) IEEE-400.2 *Guide for Field Testing of Shielded Power Cable Systems Using Very Low Frequency (VLF)*
(6) IEEE-400.3 *Guide for Partial Discharge Testing of Shielded Power Cable Systems in a Field Environment*
11.21.1.2 For further information on cables See Chapter 19, Power Cables.
11.21.1.3 Before equipment insulation is tested, it should be cleaned, inspected, and repaired as necessary to minimize leakage currents. The same action

should be taken for cable terminations. Surge arresters, capacitors, or similar equipment should be disconnected.

11.21.1.4 When cables are being tested, all transformers, switches, fuse cutouts, switchgear, or other ancillary equipment ~~and so on,~~ should be disconnected wherever practicable. ~~Thus, i~~If significant leakage currents are encountered it will be known that those currents are probably in the cable insulation and not in equipment connected thereto. If such disconnection is impractical, it might be necessary to limit the maximum test voltage to the level that such equipment can withstand without damage.

11.21.1.5 High leakage currents in cables might be due to improper preparation ~~of their ends~~ before ~~the~~ cable terminations or splices were installed, that ~~thereby~~ allowi~~ng~~ high surface leakage while under test ~~across them~~.

Substantiation: The references in 11.21.1 were updated.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-39b Log #CP8 EEM-AAA **Final Action: Accept**
(11.21.2.1.1)

TCC Action: The TCC directs that the committee revise the text to remove the mandatory word "shall" which is not allowed in a recommended practice by Section 2.4.1.3 of the NFPA Manual of Style. This shall be considered as a public comment.
Submitter: Technical Committee on Electrical Equipment Maintenance,
Recommendation: Revise 11.21.2.1.1 to read as follows:
11.21.2.1.1 **Insulation Resistance**.
11.21.2.1.1.1 Perform an insulation resistance test on each conductor with respect to ground and adjacent conductors. The applied voltage shall be 500 volts dc for 300 volt rated cable and 1000 volts dc for 600 volt rated cables. The test duration shall be one minute.
Substantiation: Section 11.21.2.1.1 was editoriallycorrected.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.
Comment on Affirmative:
BINGHAM, R.: 11.21.2.1.1.1 "shall" is not considered appropriate for a recommended practice. replace 'shall' with 'should' to read "the test duration should be one minute."

70B-39c Log #CP9 EEM-AAA **Final Action: Accept**
(11.21.3)

TCC Action: The Technical Correlating Committee directs that the committee revise the text to remove the mandatory word "must" which is not allowed in a recommended practice by Section 2.4.1.3 of the NFPA Manual of Style. This shall be considered as a public comment.
Submitter: Technical Committee on Electrical Equipment Maintenance,
Recommendation: Revise 11.21.3 to read as follows:
11.21.3 **Medium and High Voltage Cables (2.3 kV – 138 kV)**.
11.21.3.1 **Insulation Resistance**. Measure the insulation resistance individually on each conductor with all other conductors and shields grounded. Apply dc voltage in accordance with the manufacturer's published data. Insulation resistance values should be in accordance with the manufacturer's published data. In the absence of manufacturer's published data, use Table 11.21.3.1(1)

11.21.3.2 **Shield Continuity**. Measure the shield continuity on each power cable shield. Shielding should exhibit continuity. Investigate resistance values in excess of ten ohms per 1000 feet of cable.

11.21.3.3 **Medium Voltage Cable Testing Methods**. Medium voltage cable systems are typically very reliable and provide years of service, however, like all electrical equipment they begin to deteriorate from the first day of installation. There are many testing options for the field assessment of medium voltage cables. In addition to the many factors affecting test results there is not a consensus within industry as to the most reliable and repeatable testing method to employ, which in turn further complicates one's analysis of which field testing procedure should be utilized. The decision process as to which technology to utilize for field testing can be achieved by taking into account several factors. Considerations should be made as to:
(1) Cable performance and failure history.
(2) Cable system components and composition.
(3) System reliability requirements.
(4) Availability of historical testing data and previous test results.
(5) Impact to operations of a cable failure while under test.

TABLE 11.21.3.1(1) INSULATION RESISTANCE TEST VALUES
ELECTRICAL APPARATUS AND SYSTEMS

Nominal Rating of Equipment (Volts)	Minimum Test Voltage (DC)	Recommended Minimum Insulation Resistance (Megohms)
250	500	25
600	1,000	100
1,000	1,000	100
2,500	1,000	500
5,000	2,500	1,000
8,000	2,500	2,000
15,000	2,500	5,000
25,000	5,000	20,000
34,500 and above	15,000	100,000

Table Notes:
See Table 11.21.3.1(2) for temperature correction factors.
Test results are dependent on the temperature of the insulating material and the humidity of the surrounding environment at the time of the test.
Insulation-resistance test data may be used to establish a trending pattern. Deviations from the baseline information permit evaluation of the insulation.

Table courtesy of InterNational Electrical Testing Association. Source ANSI/NETA MTS-2011, Maintenance Testing Specifications for Electrical Power Distribution Equipment and Systems, Table 100.1

TABLE 11.21.3.1(2) INSULATION RESISTANCE CONVERSION FACTORS (20° C)		
Temperature		Multiplier
° C	° F	Apparatus Containing Solid Insulation
-10	14	0.25
-5	23	0.32
0	32	0.40
5	41	0.50
10	50	0.63
15	59	0.81
20	68	1.00
25	77	1.25
30	86	1.58
35	95	2.00
40	104	2.50
45	113	3.15
50	122	3.98
55	131	5.00
60	140	6.30
65	149	7.90
70	158	10.00
75	167	12.60
80	176	15.80
85	185	20.00
90	194	25.20
95	203	31.60
100	212	40.00
105	221	50.40
110	230	63.20
Table Notes: Source ANSI/NETA MTS-2011, Maintenance Testing Specifications for Electrical Power Distribution Equipment and Systems, Table 100.14.		

11.21.3.3.1 **Cable Withstand Testing at Elevated Voltages**.

11.21.3.3.1.1 **Withstand Voltage Testing Direct Current (dc)**. A dc withstand voltage test, also commonly referred to as a dc high-potential or dc hipot test, consists of applying dc voltage across a cable at or above the dc equivalent of the 60 Hz operating crest voltage. This test can be applied either as a dielectric absorption test or a step-voltage test. A dc high-potential test is an appropriate method for an acceptance test. The dc withstand voltage test should not be applied to cables over five years old.

11.21.3.3.1.2 **Withstand Voltage Testing Alternating Current (ac)**. An ac withstand voltage test at power line (60 Hz) frequencies stresses the cable insulation system by applying an ac voltage waveform similar to what the cable would experience in normal operation. It is also a similar test to the factory test on new cables.

11.21.3.3.1.3 **Withstand Voltage Testing Very Low Frequency (VLF)**. A very low frequency (VLF) test is a withstand voltage test of cable system insulation. The test is similar to a dc withstand voltage (dc hipot) test except the VLF test unit provides an ac voltage in the frequency range from 0.01 Hz to 1.0 Hz. To successfully pass the test, the cable system must withstand the test voltage (usually 3 times rated voltage or less) for a specified time (usually 1 hour or less).

11.21.3.3.2 **Cable Diagnostic Testing.**

11.21.3.3.2.1 **Dissipation Factor (Tan Delta) Testing.** Also called loss angle or insulation power factor testing, it is a diagnostic method of testing cables to determine the loss factor of the insulation material. Because the loss factor increases during the ageing process of the cable, the dissipation factor measurement can be used as a diagnostic method to predict overall cable health.

For cables, the dissipation factor of each conductor with respect to ground should be obtained, and a hot-collar test should be performed on each pothead or porcelain termination assembly.

11.21.3.3.2.2 **Partial Discharge (PD) Testing in General**. The insulation system of a medium-voltage distribution system has partial discharges into air, across surfaces, and through the insulating material. These discharges emit energy in various parts of the electromagnetic spectrum. Partial discharges appear as individual events of very short duration and are always accompanied by emissions of light, sound and heat, as well as electromagnetic pulses; and often result in chemical reactions.

The severity of these discharges is an indication of the “health” of the insulation system. PD testing measures these discharges off-line or on-line and compares them to a database of discharge signatures to determine the severity.

11.21.3.3.2.2.1 **Different Methods of PD Measuring**. Some of the different methods of measuring PD are as follows:
(1) Radio frequency interference (RFI) detection: uses an RF sensor to measure PD pulses occurring in an insulation system.
(2) Electromagnetic detection: can be made with oscilloscopes combined with other detectors.
(3) Acoustical detection: uses an ultrasonic sensor to detect PD. With power cables this method is usually applied to terminations, joints, and cable sections that are accessible so that direct contact with the device under test can be achieved.
(4) Ultraviolet detection: uses a camera that “sees” discharges into air or across surfaces.

11.21.3.3.2.2.2 **Partial Discharge (PD) Testing: Off Line**. Some advantages of off-line PD testing are:
(1) There is no direct interface with electrical components while under normal source power.
(2) PD sites can be more accurately located in an insulation system.
(3) Partial discharge inception voltage (PDIV) and partial discharge extinction voltage (PDEV) can be measured if a variable voltage source is used.
(4) PD characteristics can be obtained at different voltages, which can aid in the identification of certain types of defects.

11.21.3.3.2.2.3 **Partial Discharge (PD) Testing: On Line**. Some advantages of on-line PD testing are:
(1) Cables are not disconnected.
(2) PD characteristics can be obtained while the equipment is under normal load connection, operation, and loading patterns which can help identify certain types of defects.
(3) A system outage interrupting normal operations is not required.
Substantiation: Medium and high voltage cable testing practices and methods were added and updated.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-40 Log #75 EEM-AAA **Final Action: Reject**
(11.27)

Submitter: Michael A. Anthony, University of Michigan / Rep. APPA.ORG - Leadership in Education
Recommendation: Add to the list of electrical system tests -- utility impedance test

Chapter 11 Testing and Test Methods
11.1 Introduction.
11.2 Acceptance Tests and Maintenance Tests.
11.3 As-Found and As-Left Tests.
11.4 Frequency of Tests.
11.5 Special Precautions and Safety.
11.6 Qualifications of Test Operators.
11.7 Test Equipment.
11.8 Forms.
11.9 Insulation Testing.
11.10 Low Voltage Circuit Breakers.
11.11 Transformer Tests.
11.12 Protective Relays.
11.13 Grounding Systems.
11.14 Battery Testing.
11.15 Switches.
11.16 Medium and High Voltage Circuit Breakers.
11.17 Infrared Inspection.
11.18 Fuses.
11.19 Insulating-Liquid Analysis.
11.20 Rotating Machine Testing.
11.21 Cables.
11.22 Adjustable-Speed Drive Testing.
11.23 Switchgear and Switchboard Assemblies.
11.24 Surge Arresters.
11.25 Power Factor Correction Capacitors.
11.26 Emergency Systems.
11.27 <u>**Utility Impedance Measurements**</u>
Substantiation: This information is important for short circuit studies and flash hazard analysis -- particularly in utility services in district energy systems and where the last mile of distribution is dynamically changing in smart grid distributed control.

The instrument can be a one-time, or a recording meter, one that is permanently built. I have provided a photo and the IEEE paper describing this device.

As the author of this proposal, I am grateful to all of the authors of the IEEE paper I have provided (Using a Microporcessor-Based Instrument to Predict the Incident Energy From Arc-Flash Hazards) who built four of these devices and were generous with their time in describing the tests and results. They are, as follows:

Thomas L. Baldwin, *Senior Member, IEEE*
Michael J. Hittel, *Member, IEEE*
Lynn F. Saunders, *Fellow, IEEE*
Frank Renovich, Jr., *Member, IEEE*

My hope is that equipment manufacturers will take notice and begin manufacturing utility impedance meters (“Z-meters”) as stand-alone devices, or as a function in an existing package of service switchgear instrumentation.

Note: Supporting material is available for review at NFPA Headquarters.
Committee Meeting Action: Reject
Committee Statement: The committee finds that the submitter did not provide sufficient technical substantiation and no maintenance tasks were listed below.
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-40a Log #CP19 EEM-AAA **Final Action: Accept**
(11.27)

Submitter: Technical Committee on Electrical Equipment Maintenance,
Recommendation: Revise by adding a new section 11.27:
11.27 Test or Calibration Decal System.
11.27.1 General. After equipment testing, device testing, or calibration, a decal on equipment can communicate the condition of electrical equipment to maintenance and service personnel. This may be important for assessing the hazard risk for electrical safety procedures as well as the condition of electrical equipment.
11.27.2 Decal. After a piece of electrical equipment or device is tested and/or calibrated a color coded decal should be attached on the exterior enclosure to that particular equipment. The decal should include:
(1) Date of test or calibration
(2) Person or outside company who performed the testing or calibration
(3) Color coding indicating the service classification as described in 11.27.3
11.27.3 Service Classifications and Related Decal Color Codes.
The test or calibration decal system has a color code that communicates one of three service classifications:
(1) White Decal: Full Service
If a device passes all tests satisfactorily and has met the requirements of the testing specifications, then a white decal should be attached to the device. This indicates that the device is electrically and mechanically sound and acceptable for return to service. There may be some minor deficiencies with the equipment, but none that affect the equipment electrically or mechanically to any large degree. Examples of deficiencies include: evidence of slight corrosion, incorrect circuit ID, nameplate missing, etc.
(2) Yellow Decal: Limited Service
If the device under test has a minor problem that is not detrimental to the protective operation or major design characteristics of that particular device, then a yellow “Limited Service” decal should be attached to the device. Examples of limited service classifications include: indicating trip targets that don’t function properly, slightly lower than acceptable insulation resistance readings, chipped arc chute, etc.
(3) Red Decal: Non-Serviceable
If the device under test has a problem that is detrimental to the proper electrical or mechanical operation of that device, then a red “Non-Serviceable” decal should be attached to the device. The non-serviceable decal would be attached to the device after attempts at field repair were made. Examples of non-serviceable classifications include: no trip on one or more phases, low insulation resistance readings, mechanical trip problems, high contact resistance readings, etc. In addition, management or owner should be advised of this condition.

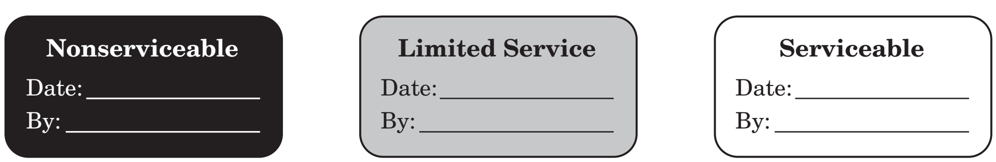

Figure 11.27(1) Examples of Service Classification Color Decals (Recommendation 70B-40)

Substantiation: It is important as maintenance personnel test equipment they have a simple system to affix to equipment to communicate the condition of that equipment. This provides important information for other personnel or maintenance personnel who later have to interface with that equipment. Out sourced testing and maintenance organizations typically have procedures similar to these and have deployed these as a routine practice.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 12 Negative: 2
Ballot Not Returned: 1 Wyman, B.
Explanation of Negative:
MANCHE, A.: If maintenance testing shows any degradation, even slight, it should be a red label, not a yellow label, and the product should be replaced. NEMA cannot support the continued customer use of any product that does not meet the factory supplied performance requirements.
REMPE, K.: If maintenance testing shows any degradation, even slight, it should be a red label, not a yellow label, and the product should be replaced. NEMA cannot support the continued customer use of any product that does not meet the factory supplied performance requirements.
Comment on Affirmative:
CRNKO, T.: I agree with Mr. White's affirmative comment. This type of calibration decal system has been widely used for decades by testing and maintenance service providers and serves an important function for workers and management. Concerning the comments by Mr. Manche and Mr. Rempe, the yellow decal for limited service is not intended to be for devices that would pose a safety hazard or would not function per specification. Possibly more explicit language edit in ROC cycle would help clarify.
WHITE, J.: Calibration stickers are a proven method to advise electrical technicians and operators of the current status of electrical power system equipment. With the calibration stickers in place, a worker no longer is required to guess at the state of the equipment's condition or attempt to find results of the latest maintenance performed. By placing a small label on the outside surface of the device or equipment it provides timely information without interfering with operation or longevity of those devices. This practice has been used for decades by several NETA-member companies with no issues. One other benefit of the labeling is that equipment owners are reminded that servicing is needed whenever they see the label. The yellow label is only used for minor issues that do not affect worker safety, while the red label indicates a serious maintenance issue that needs immediate resolution. The white label assures that the equipment is operating in a normal manner. All of these work together to provide a safer work environment

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70B-41 Log #36 EEM-AAA **Final Action: Reject**
(13.1.3.1)

Submitter: John F. Bender, Underwriters Laboratories Inc.
Recommendation: Revise text as follows:
13.1.3.1 Ground-Fault Circuit Interrupter (GFCI). A device intended for the protection of personnel that functions to deenergize a circuit or portion thereof within an established period of time when a current to ground exceeds the values established for a Class A device. Note: Class A Ground-Fault Circuit Interrupters trip when the current to ground has a value in the range of 4 mA to 6 mA. For further information, see ANSI/UL 943, *Standard for Ground-Fault Circuit Interrupters*. [70, 2008].
Substantiation: Add ANSI approval designation to ANSI/UL 943.
Committee Meeting Action: Reject
Committee Statement: The committee rejects this proposal because the extracted definition from the NEC does not include the ANSI designation.
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-42 Log #72 EEM-AAA **Final Action: Reject**
(14.1.6.46.x (New))

Submitter: Michael A. Anthony, University of Michigan / Rep. APPA.ORG - Leadership in Education - Association of Education Facility Executives
Recommendation: After the section on solidly grounded systems, add more technical information add new section 14.1.6.46+ (NEW)
14.1.6.46 Solid Grounded. Solidly grounded means that the grounded conductor is grounded without inserting any resistor or impedance device.
14.1.6.46.x Low Resistance Grounding Systems. Neutral Grounding Resistors (NGR's) limit the fault current when one phase of the system shorts or arcs to ground. In the event that a ground fault condition exists, the NGR typically limits the current to 200-400A, though most resistor manufacturers label any resistor that limits the current to 25A or greater as low resistance.
14.1.6.46.x High Resistance Grounding Systems High Resistance Grounding (HRG) systems limit the fault current when one phase of the system shorts or arcs to ground, but at lower levels than low resistance systems. In the event that a ground fault condition exists, the HRG typically limits the current to 5-10A, though most resistor manufacturers label any resistor that limits the current to 25A or less as high resistance.
14.1.6.46.x Grounding System Comparisons
Low Resistance Grounding:
1. Limits phase-to-ground currents to 200-400A.2. Reduces arcing current and, to some extent, limits arc-flash hazards associated with phase-to-ground arcing current conditions only.
3. May limit the mechanical damage and thermal damage to shorted transformer and rotating machinery windings.
4. Does not prevent operation of overcurrent devices.
5. Does not require a ground fault detection system.
6. May be utilized on medium or high voltage systems. GE offers low resistance grounding systems up to 72kV line-to-line.
7. Conductor insulation and surge arrestors must be rated based on the lineto-line voltage. Phase-to-neutral loads must be served through an isolation transformer.
High Resistance Grounding:
1. Limits phase-to-ground currents to 5-10A.
2. Reduces arcing current and essentially eliminates arc-flash hazards associated with phase-to-ground arcing current conditions only.
3. Will eliminate the mechanical damage and may limit thermal damage to shorted transformer and rotating machinery windings.
4. Prevents operation of overcurrent devices until the fault can be located (when only one phase faults to ground).
5. Requires a ground fault detection system to notify the facility engineer that a ground fault condition has occurred.
6. May be utilized on low voltage systems or medium voltage systems up to 5kV. IEEE Standard 141-1993 states that "high resistance grounding should be restricted to 5kV class or lower systems with charging currents of about 5.5A or less and should not be attempted on 15kV systems, unless proper grounding relaying is employed".
7. Conductor insulation and surge arrestors must be rated based on the lineto-line voltage. Phase-to-neutral loads must be served through an isolation transformer.
Resistance Grounding Systems have many advantages over solidly grounded systems including arc-flash hazard reduction, limiting mechanical and thermal damage associated with faults, and controlling transient overvoltages. High resistance grounding systems may also be employed to maintain service continuity and assist with locating the source of a fault. When designing a system with resistors, the design/consulting engineer must consider the specific requirements for conductor insulation ratings, surge arrestor ratings, breaker single-pole duty ratings, and method of serving phase-to-neutral loads.
Substantiation: Engineers and facility managers who design, build and operate campus-style bulk distribution grids are struggling with economical ways to provide electrical power reliably and safely (i.e. reducing flash energy). Low resistance grounded systems for campus style medium voltage distribution has particular advantages if migration to low resistance grounding from solidly grounded systems can be scaled incrementally. As long as some of the cable insulation issues can be managed, low resistance grounding is a near-silver bullet solution to many of the maintenance problems associated with very high incident energy at primary equipment for the most common type of fault - the phase-to-ground fault.
The electrical engineers who are retained by Architects in education facilities projects, for example, should present resistance grounding options their clients as a safety and maintenance solution. Installing this passage into NFPA 70B will enliven the discussion among planners and designers of campus-style medium voltage distribution grids as well as inform many smart-grid, interactive grid concepts going forward.
Much of this material has been derived from the following sources: "Resistance Grounding System Basics", By Michael D. Seal, P.E., General Electric E Senior Specification Engineer and "Innovative Techniques for Mitigating Arc Flash Exposure" by David Shipp at Eaton Corporation.
Committee Meeting Action: Reject
Committee Statement: The committee rejects because there are no action statements and maintenance tasks required. The committee further finds that it is tutorial in nature and does not enhance the purpose of the document. The committee recognizes the value of this information as design criteria.
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-42b Log #CP4 EEM-AAA **Final Action: Accept**
(14.1.6.49 (New))

TCC Action: The Technical Correlating Committee directs that the committee review the proposed text and either list all the possible wiring methods available or refer the user of the document to NFPA 70 for further grounding information and requirements. This shall be considered as a public comment.
Submitter: Technical Committee on Electrical Equipment Maintenance,
Recommendation: Add new section 14.1.6.49
14.1.6.49 **Luminaire Grounding**.
14.1.6.49.1 Inspect to verify that the luminaires (fixtures) are properly grounded.
(1) If the wiring method utilizes a metallic armored cable wiring method or nonmetallic-sheathed cable with ground, proper connection of the wiring provides an acceptable equipment ground. Grounding of a surface-mounted luminaire is accomplished by securing the luminaire to a properly grounded metal outlet box. Metal outlet boxes have a location to place a grounding

screw. The bare copper equipment grounding conductor in the nonmetallic sheathed cable is usually terminated under this screw.
(2) If the outlet box is nonmetallic, the small bare equipment grounding conductor from the luminaire is connected to the equipment grounding conductor in the outlet box. For suspended ceiling luminaires, grounding of the luminaire is accomplished by using metallic fixtures whips or nonmetallic-sheathed cable with ground between the outlet box and the luminaire.
14.1.6.49.2 If there is no equipment grounding means found, refer to NFPA 70 for proper grounding.

Substantiation: In reviewing the lighting chapter 23, it was noted that proper grounding of luminaires should be covered in the maintenance inspection procedure. It was determined that the new material would be more appropriately placed in the grounding chapter.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-43 Log #42 EEM-AAA **Final Action: Accept in Principle in Part**
(15.9.4.1, 15.9.4.1.1, and 15.9.4.1.2)

Submitter: Steve McCluer, Schneider Electric / Rep. IEEE Stationary Battery Committee
Recommendation: Revise text to read as follows:

~~**15.9.4.1 General.** Stationary batteries are a primary power source for critical systems, ac power generation equipment, switchgear, and control circuits. Stationary batteries also provide backup power for essential equipment during outages of the primary power supply. Because these applications require reliable service, stationary batteries should be serviced regularly. The maintenance required depends on each battery's application, type, construction features and materials, and environment.~~

~~**15.9.4.1.1** Lead–acid batteries are of two technologies: flooded wet cell design and sealed valve regulated lead–acid (VRLA) designs. Stationary batteries are typically lead–acid batteries with lead–antimony or lead–calcium grids. Some stationary batteries are nickel–cadmium (Ni-Cad) units. VRLA batteries have a shorter service life than flooded cells, cannot be tested in the same manner, and are not addressed in this document.~~

~~**15.9.4.1.2** Battery chargers play a critical role in battery maintenance because they supply normal dc requirements and maintain batteries at appropriate levels of charge. Chargers should be set and maintained according to manufacturers' instructions.~~

15.9.4.1 General. Stationary batteries are most often used as the reserve power source for critical equipment during power outages. These batteries are typically vented lead-acid (VLA) batteries consisting of either lead calcium or lead antimony grids. Other technologies may be utilized in these applications but are not specifically addressed in the following paragraphs. Due to the reliability requirements for these applications, specific safety guidelines as well as well defined maintenance practices should be utilized to ensure a reliable system. The following sections offer guidance on the safety and maintenance requirements. In addition, the manufacturers' recommendations should be followed and the appropriate IEEE standards should be referred to for additional information.

Substantiation: This proposal is one of a series by the IEEE Stationary Battery committee.

- The existing "General" paragraph does not summarize the intent of Section 15.9.4. It mentions things that are not actually discussed later.
- Paragraph 15.9.4.1.2 can be deleted as it is commentary and adds no guidance for procedures.
- Chargers should be beyond the scope of para 15.9.4., which is actually about batteries with only the briefest mention of chargers.
- Almost all batteries used in substation and switchgear applications are vented lead-acid, with an occasional VRLA or Ni-Cd (described as "other technologies" in this proposal).
- Many of the subsequent paragraphs in the 2010 edition address only vented lead-acid batteries.

A separate proposal recommends the addition of a new section for references to battery maintenance standards.

Committee Meeting Action: Accept in Principle in Part

Revise the text of the recommendation to read as follows:

15.9.4.1 General. Stationary batteries are a power source for critical systems, ac power generation equipment, switchgear, and control circuits. Stationary batteries are most often used as the reserve power source for critical equipment during power outages. These batteries are typically vented lead-acid (VLA) batteries consisting of either lead calcium or lead antimony grids. Other technologies may be utilized in these applications but are not specifically addressed in the following paragraphs. Due to the reliability requirements for these applications, specific safety guidelines as well as well defined maintenance practices should be utilized to ensure a reliable system. The following sections offer guidance on the safety and maintenance requirements. In addition, the manufacturers' recommendations should be followed and the ~~appropriate~~ applicable IEEE standards should be referred to for additional information.

~~**15.9.4.1.1** Lead–acid batteries are of two technologies: flooded wet cell design and sealed valve regulated lead–acid (VRLA) designs. Stationary batteries are typically lead–acid batteries with lead–antimony or lead–calcium grids. Some stationary batteries are nickel–cadmium (Ni-Cad) units. VRLA batteries have a shorter service life than flooded cells, cannot be tested in the same manner, and are not addressed in this document..~~

~~**15.9.4.1.2**~~ 15.9.4.1.1 Battery chargers play a critical role in battery maintenance because they supply normal dc requirements and maintain batteries at appropriate levels of charge. Chargers should be set and maintained according to manufacturers' instructions.

Committee Statement: The committee accepts the revisions to 15.9.4.1 and added a new first sentence to clarify the function of the battery in these types of systems and changed "appropriate" to "applicable" in the last sentence.

The committee accepts the deletion of 15.9.4.1.1.

The committee rejects the removal of 15.9.4.1.2 and has renumbered it as 15.9.4.1.1. The committee finds that the information is important to the user of the document and the substantiation was not sufficient to justify its removal since the battery charger is an integral part of the system.
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-44 Log #43 EEM-AAA **Final Action: Accept**
(15.9.4.1.1 (New))

Submitter: Steve McCluer, Schneider Electric / Rep. IEEE Stationary Battery Committee
Recommendation: Add new text to read as follows:

15.9.4.1.1 References The following should be considered for specific maintenance, repair considerations, and procedures:
(1) IEEE Std 450 – IEEE Recommended Practice for Maintenance, Testing and Replacement of Vented Lead-Acid Batteries for Stationary Applications
(2) IEEE Std 1188 – IEEE Recommended Practice for Maintenance, Testing and Replacement of Valve-Regulated Lead-Acid (VRLA) Batteries for Stationary Applications
(3) IEEE Std 1106 – IEEE Recommended Practice for Installation, Maintenance, Testing and Replacement of Vented Nickel-Cadmium Batteries for Stationary Applications
(4) IEEE Std 1145 – IEEE Recommended Practice for Installation and Maintenance of Nickel-Cadmium Batteries for Photovoltaic (PV) Systems
(5) IEEE Std 1657 – IEEE Recommended Practice for Personnel Qualifications for Installation and Maintenance of Stationary Batteries

Substantiation: This proposal would add a section for references. The paragraph number depends upon action on other proposals.

Items 1-4 cite industry standards for maintenance of vented lead-acid, VRLA, and Ni-Cd batteries.

Item 5 cites a recent standard for certification of battery technicians in order to identify an individual as "qualified."
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-45 Log #44 EEM-AAA **Final Action: Accept in Part**
(15.9.4.2)

Submitter: Steve McCluer, Schneider Electric / Rep. IEEE Stationary Battery Committee
Recommendation: Revise text to read as follows:

Maintenance Program. Battery maintenance normally consists of periodic inspections and tests. As a minimum, a maintenance program should be established based on manufacturers' installation and operation manuals. Ideally, other standards such as IEEE recommended practices applicable to the battery design may also be consulted, as these are frequently called out in the manufacturer's manuals. For further information on testing see 11.14, Battery Testing. ~~Visual inspections include checking electrolyte level and internal conditions in jar-type cells. Many battery problems can be detected by visual inspections. Tests aid in evaluating performance and permit comparisons with standards and with historical test results. Battery manufacturers are good sources of information for maintenance programs.~~

Substantiation: Delete sentences #2 through 5 of paragraph 15.9.4.2 as they do not give any specifics about what visual inspection should look for on any given type of battery or how to interpret what is observed.

The revised text clarifies that procedures will vary from one battery technology to another. For example, checking electrolyte levels is not possible on a VRLA battery. Detailed procedures are provided by the battery manufacturers and/or standards written specifically for the type of battery. The existing text references "standards" but doesn't identify what they are. IEEE standards are the most commonly referenced standards for stationary battery installation and maintenance. A separate proposal recommends adding a paragraph in 15.9.4 to list the appropriate standards (which are also included in 11.14.1).

In the final sentence we recommend add the name of the referenced section in NFPA 70B.

Committee Meeting Action: Accept in Part
Revise the text of the recommendation to read as follows:
Maintenance Program. Battery maintenance normally consists of periodic inspections and tests. As a minimum, a maintenance program should be established based on manufacturers' installation and operation manuals. Ideally, other standards such as IEEE recommended practices applicable to the battery design may also be consulted, as these are frequently called out in the manufacturer's manuals. For further information on testing see 11.14, Battery Testing. Visual inspections include checking electrolyte level and internal conditions in jar-type cells. Many battery problems can be detected by visual inspections. Tests aid in evaluating performance and permit comparisons with standards and with historical test results. Battery manufacturers are good sources of information for maintenance programs.
Committee Statement: The committee did not accept the wording referring to IEEE recommended practices because it is adequately covered in the Committee Action taken Proposal 70B-43 (Log #42).
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-46 Log #45 EEM-AAA **Final Action: Accept**
(15.9.4.3)

Submitter: Steve McCluer, Schneider Electric / Rep. IEEE Stationary Battery Committee
Recommendation: Revise text to read as follows:
15.9.4.3 Safety Guidelines. Personnel should be aware of the hazards associated with stationary batteries. Voltages present can cause injury and death Exposing skin and eyes to electrolyte can cause severe burns and blindness A battery can produce and emit a mixture of hydrogen and oxygen gas that is explosive. Vented lead-acid batteries can emit a mixture of hydrogen and oxygen gas. Under abnormal conditions, such as a lack of space ventilation, it is possible for the mixture to reach a flammable level. Exposing skin and eyes to electrolyte can cause severe burns and blindness. Voltages present can cause injury and death. As a minimum, the safety precautions in 15.9.4.3.1 through 15.9.4.3.7 should be observed.
Substantiation: The existing language of 15.9.4.3 exaggerates the hazards. A vented battery that is properly installed, maintained, and operated in a properly ventilated space will not create explosive levels of gas. It is only under abnormal conditions that such a condition can occur. We recommend reorganizing the list of hazards by priority, with electrical shock being the greatest concern.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-47 Log #46 EEM-AAA **Final Action: Reject**
(15.9.4.3.1)

Submitter: Steve McCluer, Schneider Electric / Rep. IEEE Stationary Battery Committee
Recommendation: Revise text to read as follows:
Maintenance personnel should be trained to perform the tasks properly . Training should include using personal protective equipment, handling the electrolyte safely, using the proper tools, and following the battery manufacturer's service and maintenance instructions and using recommended tools.
Substantiation: This list in 15.9.4.3.1 is not all-inclusive. Refer to the manufacturer's instructions for the skills required for a specific battery technology, and which frequently refer to other standards such as IEEE battery standards and NFPA 70E. The latter go into more detail about the levels and types of skills required. IEEE Standard 1657 gives detailed curriculum for certifying battery technicians in order to determine when a person is "qualified".
Committee Meeting Action: Reject
Committee Statement: The substantiation does not give adequate reason for removing the requirements.
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-48 Log #47 EEM-AAA **Final Action: Reject**
(15.9.4.3.2)

Submitter: Steve McCluer, Schneider Electric / Rep. IEEE Stationary Battery Committee
Recommendation: Delete text as follows:
15.9.4.3.2 The room or compartment in which operating lead–acid batteries are located should be ventilated adequately.
Substantiation: Delete paragraph 15.9.4.3.2 and renumber subsequent paragraphs. This is a design issue, not a maintenance issue. This requirement is appropriate for the National Electrical Code, Fire Code, or Mechanical Code. It is inappropriate for an electrical equipment maintenance standard. The appropriate battery maintenance is to verify that any room or compartment ventilation system is operating. Paragraph 15.9.4.4.6 addresses inspection of ventilation system(s).
Committee Meeting Action: Reject
Committee Statement: The committee does not agree that determining if adequate ventilation is available is a design issue.
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-49 Log #48 EEM-AAA **Final Action: Accept**
(15.9.4.3.3)

Submitter: Steve McCluer, Schneider Electric / Rep. IEEE Stationary Battery Committee
Recommendation: Revise text to read as follows:
15.9.4.3.3 Appropriate safety equipment should be worn used in accordance with NFPA 70E and manufacturer's instructions. , including goggles, gloves, and aprons, by persons working with the batteries. Eyewash and quick drench facilities should be provided near the batteries.
Substantiation: NFPA 70E and the battery manufacturers specify the safety equipment and tools for battery installation and maintenance. Safety equipment also includes items that are not "worn".
Provision for eye wash stations is a facility design issue, not a maintenance issue. Installation requirements are the jurisdiction of the National Electrical Code.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-50 Log #49 EEM-AAA **Final Action: Accept**
(15.9.4.3.5)

Submitter: Steve McCluer, Schneider Electric / Rep. IEEE Stationary Battery Committee
Recommendation: Revise text to read as follows:
Metal Conductive objects should not be placed on used near battery cells. Insulated tools should be used to protect against shorting of cells.
Substantiation: Replace "metal" with "conductive," as objects can be conductive but not necessarily metal. Conductive objects should not be placed on or used near the conductive elements of a battery system.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-51 Log #50 EEM-AAA **Final Action: Accept**
(15.9.4.3.6)

Submitter: Steve McCluer, Schneider Electric / Rep. IEEE Stationary Battery Committee
Recommendation: Delete text as follows:
15.9.4.3.6 When electrolyte is being prepared, personal protective equipment should include a full-face shield. POUR ACID INTO WATER, NOT WATER INTO ACID. If the electrolyte comes in contact with skin or eyes, the affected area should be immediately flushed with water and medical assistance obtained
Substantiation: Delete paragraph 15.9.4.3.6. PPE is addressed in other paragraphs. Mixing acid and water in the field is not a standard practice (is really the rare exception). The standard practice is just to add water to a cell. On the rare occasions when the addition of acid is required, the electrolyte is almost always obtained from the manufacturer at the proper specific gravity.
We should point out that this document also addresses Nickel-Cadmium batteries. You never put acid in a Ni-Cd battery, in which the active chemical is Potassium Hydroxide (an alkaline agent). Refer to the MSDS for the appropriate first aid for the chemicals in a specific type of battery.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-52 Log #51 EEM-AAA **Final Action: Accept**
(15.9.4.3.7)

Submitter: Steve McCluer, Schneider Electric / Rep. IEEE Stationary Battery Committee
Recommendation: Revise text to read as follows:
15.9.4.3.7 Unauthorized access to the battery area exposed batteries should be prohibited.
Substantiation: As written, this paragraph only applies when the batteries are located in a battery room or other restricted area in which batteries are installed in open racks. Often batteries are collocated with other equipment where access is required by several technical and operating personnel, in which case batteries are typically secured in cabinets. In these cases, cabinets should be locked and appropriate warning signs should be displayed.

Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-53 Log #52 EEM-AAA **Final Action: Accept**
(15.9.4.4)

Submitter: Steve McCluer, Schneider Electric / Rep. IEEE Stationary Battery Committee
Recommendation: Revise text as follows:
Guide for Visual~~, Mechanical and Electrical~~ Inspections of Electrical and Mechanical Equipment.
Substantiation: Reword the title of paragraph 15.9.4.4. to clarify that it is for visual inspections only, of both mechanical and electrical equipment. All of the following sub-paragraphs address only visual inspection.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-54 Log #53 EEM-AAA **Final Action: Accept**
(15.9.4.4.1)

Submitter: Steve McCluer, Schneider Electric / Rep. IEEE Stationary Battery Committee
Recommendation: Revise text to read as follows:
~~Jars~~ Containers and covers should be checked for cracks and structural damage~~. Maintenance of flame arrester–type vent caps should consist of rinsing them in clear water and air drying~~. Damaged units and damaged or missing removable vent caps should be replaced.
Substantiation: The slang term "jars" is technically incorrect; the term "container" should be substituted wherever the term "jars" is used in this document.
Cleaning of flame arrestors is not a standard battery maintenance routine and is not recommended as it can introduce contaminants into the electrolyte, it can create a potentially hazardous condition if flame arrestors are removed more than briefly, and flame arrestor vent caps cannot be serviced on VRLA or similar batteries. Damaged or missing vent caps should be replaced.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-55 Log #70 EEM-AAA **Final Action: Accept in Principle**
(15.9.4.4.2)

Submitter: Steve McCluer, Schneider Electric / Rep. IEEE Stationary Battery Committee
Recommendation: Revise text to read as follows:
15.9.4.4.2 Plates and internal parts ~~of~~ within clear ~~jars~~ containers should be checked for damages such as buckling, warping, scaling, swelling, cracking, hydration rings, excessive sedimentation, mossing, copper contamination, internal post seal cracks, and changes in color. ~~Damaged~~ Questionable cells should be ~~replaced~~.evaluated for repair or replacement.
Substantiation: The term "jars" is technically incorrect; the term "container" should be used wherever the term "jars" is used in this document. Internal parts should also be checked for a lot more than what is presently identified. Sometimes minor damage can be repaired. Some degree of battery defect can be tolerated or repaired.
Committee Meeting Action: Accept in Principle
Revise the recommendation as follows:
15.9.4.4.2 Plates and internal parts ~~of~~ within clear ~~jars~~ containers should be checked for damage~~s~~ such as buckling, warping, scaling, swelling, cracking, hydration rings, excessive sedimentation, mossing, copper contamination, internal post seal cracks, and changes in color. ~~Damaged Questionable~~ Cells Eexhibiting any of these characterisitcs ~~cells~~ should be ~~replaced~~. evaluated for repair or replacement.
Committee Statement: The committee changed the word "damages" to "damage" for editorial purposes and the last sentence of the recommended text was revised to provide clarity and eliminate subjective wording.
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-56 Log #71 EEM-AAA **Final Action: Accept**
(15.9.4.4.3)

Submitter: Steve McCluer, Schneider Electric / Rep. IEEE Stationary Battery Committee
Recommendation: Revise text to read as follows:
15.9.4.4.3 The charger should be checked for proper operation. Interconnection cables, cell connectors, and other conductors should be examined for wear, contamination, corrosion, and discoloration. Racks should be checked for corrosion, cleanliness, proper grounding, and structural integrity.
Substantiation: Grounding can also be affected by the same issues cited in the previous sentence.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-57 Log #69 EEM-AAA **Final Action: Accept**
(15.9.4.4.4)

Submitter: Steve McCluer, Schneider Electric / Rep. IEEE Stationary Battery Committee
Recommendation: Revise text to read as follows:
15.9.4.4.4 A check should be made for spilled electrolyte. A solution of water and bicarbonate of soda (baking soda) ~~solution~~ should be used to neutralize lead–acid battery spills, and a solution of boric acid and water ~~solution~~ should be used for Ni-Cad spills. The battery manufacturer's instructions should be consulted for proper proportions.
Substantiation: Battery manufacturer's instructions would indicate the proper solution and dilution.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-58 Log #54 EEM-AAA **Final Action: Accept**
(15.9.4.4.5)

Submitter: Steve McCluer, Schneider Electric / Rep. IEEE Stationary Battery Committee
Recommendation: Revise text to read as follows:
15.9.4.4.5 The electrolyte level before water addition, should be checked and corrective measures should be noted in accordance with the owner's maintenance program and the manufacturer's recommendations. ~~It should be determined that electrolyte and cells are clear, with minimal deposits, gassing, or rings, and that there is only minor sediment below the plates. The amounts of water added to the cells should be recorded.~~ Excessive water consumption can be a sign of overcharging or cell damage. For lead–antimony batteries, water consumption increases gradually with age. Distilled or deionized water should be used unless otherwise recommended by the battery manufacturer.
CAUTION: Never add ~~acid~~ anything but water to a battery ~~when refilling.~~ unless recommended to do so by the manufacturer.
Substantiation: ● It is assumed that there is already a maintenance program established to address inspection and recording of electrolyte levels.
● The items in the second sentence are already addressed in previous paragraphs (see 15.9.4.4.2)
● The 3rd sentence is already addressed w/ revisions to the 1st sentence.
● re: 4th sentence: Partial cell shorts can cause excessive water consumption.
● In large battery installations it can often be less expensive to install deionization equipment than to buy distilled water for battery watering. Properly maintained deionization equipment can and does provide perfectly suitable water for batteries.
● re Caution: delete the words "when refilling" as they are not needed. Acid, electrolyte, or anything else should not be added unless specifically instructed to do so by the manufacturer.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-59 Log #55 EEM-AAA **Final Action: Accept**
(15.9.4.4.6)

Submitter: Steve McCluer, Schneider Electric / Rep. IEEE Stationary Battery Committee
Recommendation: Revise text to read as follows:
15.9.4.4.6 Ventilation and the suitability and condition of electrical equipment in the area should be checked for its possible effect on the battery. ~~Battery proximity to combustibles and ignition sources should be evaluated~~. Local sources of heating and cooling can create cell temperature differentials that cause battery damage. Battery room ventilation openings should be checked to be sure they are clear of obstructions.
Substantiation: Both heating and cooling - or lack thereof - can affect battery performance.
Delete the 2nd sentence as it is already addressed in paragraph 15.9.4.3.4
Add the final sentence, which is moved from 15.9.4.4.13 because it fits better here (see separate proposal on 15.9.4.4.13).
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-60 Log #56 EEM-AAA **Final Action: Accept**
(15.9.4.4.7)

Submitter: Steve McCluer, Schneider Electric / Rep. IEEE Stationary Battery Committee
Recommendation: Revise text to read as follows:
15.9.4.4.7 Ambient temperature should be checked to be within the manufacturer's recommended range. ~~The optimum ambient operating temperature for lead–acid batteries is~~ 20~~25°C (~~68 -~~77°F). Ni-Cad batteries can operate satisfactorily over a~~ greater ~~range of temperatures, generally from 25°C to 45°C (77~~ 41 ~~°F to 113°F)~~. High ambient temperatures reduce cell life. ~~Every 9~~ 8.4~~°C (15°F) increase in temperature above 25°C (77°F) can reduces lead–acid cell life by up to 50 percent and Ni-Cad cell life by up to 20 percent~~. Lower ambient cell temperatures reduce cell capacity (~~A lead-acid battery operating at 16°C (60°F) loses about 10 percent of its designed capacity.~~
Substantiation: The values cited in the existing text can vary from one manufacturer to another depending upon many variables. The technician should make sure that ambient temperature is within the range specified by the battery manufacturer.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-61 Log #57 EEM-AAA **Final Action: Reject**
(15.9.4.4.8)

Submitter: Steve McCluer, Schneider Electric / Rep. IEEE Stationary Battery Committee
Recommendation: Delete text as follows:
~~**15.9.4.4.8** Area heating, air conditioning, seismic protection, dc circuit overcurrent protection, distilled water supply, alarm circuits, grounding connections, cable clamps, and all other installed protective systems and devices should be checked.~~
Substantiation: Delete 15.9.4.4.8 and renumber subsequent paragraphs. The activities listed here apply to infrastructure inspection, not battery maintenance. These responsibilities fall within the infrastructure management group or the fire marshals' office.
Committee Meeting Action: Reject
Committee Statement: The committee finds that the substantiation is not sufficient as the section already covers other components of the battery system including building components. Section 15.9.4.4.8 directly applies to visual, mechanical and electrical inspections.
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-62 Log #58 EEM-AAA **Final Action: Accept**
(15.9.4.4.9 (New))

Submitter: Steve McCluer, Schneider Electric / Rep. IEEE Stationary Battery Committee
Recommendation: Add new text to read as follows:
15.9.4.4.9 Voltage potential between the battery's most positive and most negative terminals should be verified to be within the manufacturer's recommended float voltage range for the observed ambient temperature.
Substantiation: *Insert a new 15.9.4.4.9 and renumber all subsequent paragraphs.*
High or low voltage can be a sign of charger failure, improper setting, charger malfunction, or excessive voltage drop in the wiring. This is a charger issue, not a battery issue.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-63 Log #59 EEM-AAA **Final Action: Accept in Part**
(15.9.4.4.10)

Submitter: Steve McCluer, Schneider Electric / Rep. IEEE Stationary Battery Committee
Recommendation: Revise text to read as follows:
15.9.4.4.10 Lead–acid battery surfaces should be cleaned with a mild solution of water and sodium bicarbonate to avoid leakage currents caused by electrolyte on the battery. Ni-Cad battery surfaces should be cleaned with a solution of boric acid and water. ~~solution~~. Cleaners, soaps, or solvents should not be used to clean battery containers ~~jars~~ and covers, since damage can result. Consult the battery manufacturer for the proper solution and dilution.
Substantiation: Battery manufacturer's would indicate the proper solution and dilution.
The slang term "jars" should be replaced with the proper term "containers" wherever used in this document.
Compare this to Paragraph 15.9.4.4.4
Committee Meeting Action: Accept in Part
Revise existing text as follows:
15.9.4.4.10 Lead–acid battery surfaces should be cleaned with a ~~mild~~ solution of water and sodium bicarbonate to avoid leakage currents caused by electrolyte on the battery. Ni-Cad battery surfaces should be cleaned with a solution of boric acid and water ~~solution~~. Cleaners, soaps, or solvents should not be used to clean battery containers ~~jars~~ and covers, since damage can result. Consult the battery manufacturer for the proper solution and dilution.
Committee Statement: The committee did not accept the word "mild" because it is undefined and subjective.
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-64 Log #60 EEM-AAA **Final Action: Accept in Principle**
(15.9.4.4.11)

Submitter: Steve McCluer, Schneider Electric / Rep. IEEE Stationary Battery Committee
Recommendation: Revise text to read as follows:
15.9.4.4.11 ~~The intercell connectors (links) should be checked annually and torqued to specified values.~~ All battery connections should be checked on a routine basis for high connection resistance. When a connection resistance is high then the connections should be cleaned and re-torqued in accordance with the manufacturer's procedures.
Substantiation: Many manufacturers no longer recommend to re-torque annually as this practice leads to deformation and over-stressing of the posts. Furthermore, it does not guarantee a good connection.
Committee Meeting Action: Accept in Principle
Revise text to read as follows:
15.9.4.4.11 ~~The intercell connectors (links) should be checked annually and torqued to specified values.~~ All battery connections should be checked on a routine basis for high connection resistance. When the resistance of a connection is in excess of 50% of the lowest measured resistance of similar connections, then the connection should be cleaned and torqued in accordance with the manufacturer's procedures.
Committee Statement: The committee found that the term high resistance connection was subjective and required clarification. The source of the 50% resistance value came from ANSI/NETA MTS-2011.
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-65 Log #61 EEM-AAA **Final Action: Reject**
(15.9.4.4.12)

Submitter: Steve McCluer, Schneider Electric / Rep. IEEE Stationary Battery Committee
Recommendation: Delete text as follows:
~~**15.9.4.4.12** Alarm relays, lights, and horns should be checked for proper operation. The battery room emergency lighting should be checked.~~
Substantiation: Delete paragraph 15.9.4.4.12 and renumber subsequent paragraph(s). Existing text adds no clear instruction. No guidance is given for what to check for or where to get the information. All of these should be addressed in detail in the owner's maintenance program manual.
The activities listed here describe infrastructure inspection, not battery maintenance. These responsibilities fall within the infrastructure management group or the fire marshals' office.
Committee Meeting Action: Reject
Committee Statement: The committee finds that the substantiation is not sufficient as the section already covers other components of the battery system including building components. Section 15.9.4.4.12 directly applies to visual, mechanical and electrical inspections.
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-66 Log #62 EEM-AAA **Final Action: Accept**
(15.9.4.4.13)

Submitter: Steve McCluer, Schneider Electric / Rep. IEEE Stationary Battery Committee
Recommendation: Delete text as follows:
~~**15.9.4.4.13** Battery room ventilation openings should be checked to be sure they are clear of obstructions.~~
Substantiation: Delete paragraph 15.9.4.4.13 and move the statement to 15.9.4.4.6 where ventilation is addressed.
See separate proposal for 15.9.4.4.6.
Committee Meeting Action: Accept
Committee Statement: The committee accepts but acknowledges that the exact wording was relocated to 15.9.4.4.6. See Proposal 70B-59 (Log 55).
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-67 Log #63 EEM-AAA **Final Action: Accept**
(15.9.4.5.1)

Submitter: Steve McCluer, Schneider Electric / Rep. IEEE Stationary Battery Committee
Recommendation: Delete text as follows:
~~**15.9.4.5.1** Excessive gassing can result from overcharging.~~
Substantiation: Delete paragraph 15.9.4.5.1 and renumber subsequent paragraphs. Gassing is addressed in proposal for 15.9.4.3.
Committee Meeting Action: Accept
Committee Statement: The committee accepts but acknowledges that the exact wording was relocated to 15.9.4.3. See proposal 70B-46 (Log 45).
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-68 Log #64 EEM-AAA **Final Action: Reject**
(15.9.4.5.2)

Submitter: Steve McCluer, Schneider Electric / Rep. IEEE Stationary Battery Committee
Recommendation: Delete text as follows:
~~**15.9.4.5.2** Vibration reduces battery life. Excessive vibration can be detected by observing vibration of plates and sediment in the jar.~~
Substantiation: Delete 15.9.4.5.2 and renumber subsequent paragraphs. Vibration does reduce life, but it is more likely to be a problem before it can be detected by visual observation. If construction next door or some other source of vibration causes excess sedimentation or plate cracking, there is not much that a maintenance technician can do about it.
Committee Meeting Action: Reject
Committee Statement: The committee finds that the proposal's substantiation validates the requirement and does not warrant removal.
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-68a Log #CP17 EEM-AAA **Final Action: Accept**
(15.9.4.5.2)

Submitter: Technical Committee on Electrical Equipment Maintenance,
Recommendation: Add new text as follows:
15.9.4.5.2 Vibration reduces battery life. Excessive vibration can be detected by observing vibration of plates and sediment in the jar. If this condition is observed, then steps to reduce the vibration source, isolate the batteries from the vibration, and/or plan for an earlier scheduled replacement of the batteries than normal.

Substantiation: Committee wanted to provide the user guidance on what actions should be taken if vibration is determined to be a factor that may lead to shortening of the battery's life.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-69 Log #65 EEM-AAA **Final Action: Accept**
(15.9.4.5.3)

Submitter: Steve McCluer, Schneider Electric / Rep. IEEE Stationary Battery Committee
Recommendation: Delete text as follows:
~~**9.9.4.5.3** A lead–acid battery electrolyte begins to freeze at -29°C (-20°F), but it can freeze at warmer temperatures if its specific gravity is low. Once ice crystals form, damage to the cell is irreparable.~~
Substantiation: Delete text of 15.9.4.5.3 and renumber subsequent paragraphs. The statement in 9.9.4.5.3 adds little or no maintenance guidance. The values stated are technically incorrect because the freezing point is a function of the specific gravity of the battery electrolyte. If a battery is installed into an environment that is so far below the manufacturer's recommended operating temperature that it freezes, this is not a service issue but an application design issue. If the water in the battery freezes, the technician already knows he has a problem. The correct action is to install the battery in an environment at which temperature can be maintained above the manufacturer's minimum recommended operating level. Installation design is beyond the scope of this document.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-70 Log #66 EEM-AAA **Final Action: Accept**
(15.9.4.5.4)

Submitter: Steve McCluer, Schneider Electric / Rep. IEEE Stationary Battery Committee
Recommendation: Delete text as follows:
~~**15.9.4.5.4** Hydration occurs when a lead–acid battery is overdischarged without an immediate recharge, or when a dry-charge battery is accidentally filled with water. A sign of hydration is a whitish ring in the jar, which eventually shorts the positive and negative plates. Hydration is an irreversible condition.~~
Substantiation: The statement in 15.9.4.5.4, while generally correct, is tutorial and gives no guidance for corrective action. Inspection for hydration rings was covered previously in our proposal for 15.9.4.4.2.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-71 Log #67 EEM-AAA **Final Action: Accept**
(15.9.4.5.5)

Submitter: Steve McCluer, Schneider Electric / Rep. IEEE Stationary Battery Committee
Recommendation: Delete text to read as follows:
~~Overcharging of lead-acid cells or charging at excessive rates leads to mossing. Mossing is the development of sponge-like material high on the negative plates and the resulting sedimentation in the cells. Continued mossing shorts out the plates.~~
Substantiation: The statement in 15.9.4.5.5, while generally correct, is tutorial and gives no guidance for corrective action. Inspection for mossing was covered previously in our proposal for 15.9.4.4.2.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-72 Log #68 EEM-AAA **Final Action: Accept**
(15.9.4.5.6)

Submitter: Steve McCluer, Schneider Electric / Rep. IEEE Stationary Battery Committee
Recommendation: Revise text to read as follows:
~~The average battery~~ can ~~tolerates approximately 50 full discharges in its life~~. Some lead-acid batteries support as few as 50 full discharges while others can tolerate over 1000 discharges, depending upon the battery construction and the depth of discharges. Excessive discharges can shorten the life of a battery. Fully discharging a stationary battery more than twice in one year ~~can reduce its life~~ is not recommended.
Substantiation: The existing text suggests that lead-acid batteries can only be discharged 50 times. While that can be true for certain types of lead-acid batteries, it is not true of all, and it errs on the low side. 200 to 250 discharge cycles is not uncommon, and certain types of lead-acid batteries, such as tubular cells, can handle over 1000 cycles.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-72a Log #CP6 EEM-AAA **Final Action: Accept**
(Chapter 19)

TCC Action: The Technical Correlating Committee directs that the committee revise the text to remove the mandatory word "must" which is not allowed in a recommended practice by Section 2.4.1.3 of the NFPA Manual of Style. This shall be considered as a public comment.
Submitter: Technical Committee on Electrical Equipment Maintenance,
Recommendation: Revise Chapter 19 as follows:
Chapter 19 Power Cables
19.1 **Introduction**. Preventive maintenance is one of the best ways to ensure continued reliable service from electrical cable installations. Visual inspection and electrical testing of the insulation are the major maintenance procedures. However, it should be stressed that no amount of maintenance can correct improper application or physical damage done during installation.
19.2 **Visual and Mechanical Inspection**.
19.2.1 If in addition to visual inspection, cables are to be moved or touched, they should be deenergized.
19.2.2 Cables in manholes should be inspected for sharp bends, physical damage, excessive tension, oil leaks, pits, cable movement, insulation swelling, soft spots, cracked jackets in nonlead cables, damaged fireproofing, poor ground connections, deterioration of metallic sheath bonding, as well as corroded and weakened cable supports and the continuity of any main grounding system. Terminations and splices of nonlead cables should be ~~squeezed in search of soft spots and~~ inspected for tracking or signs of corona. The ground braid should be inspected for corrosion and tight connections. The

bottom surface of the cable should be inspected for wear or scraping, due to movement, at the point of entrance into the manhole and also where it rests on the cable supports.

19.2.3 The manhole should be inspected for ~~spalling concrete or~~ deterioration of the concrete, both internal and above ground ~~portion~~. In some instances, the manhole can be equipped with drains, which might require cleaning. In some instances, it might be necessary to pump water from the manhole prior to entrance. A manhole should not be entered unless a test for dangerous gas has been made and adequate ventilation is provided. The inspection crew should always consist of two or more persons with at least one remaining outside the manhole, and the rules and regulations for confined space entry should be followed. *[See OSHA requirements in 29 CFR 1910.146, "Permit-Required Confined Spaces," for practices and procedures to protect employees from the hazards of entry into permit-required confined spaces, and 29 CFR 1910.269(e), "Electric Power Generation, Transmission, and Distribution," Enclosed Spaces, for enclosed space entry.]*

19.2.4 Potheads, a type of insulator with a bell or pot-like shape typically used to connect underground electrical cables to overhead lines, should be inspected for oil or compound leaks and cracked or chipped porcelain. The porcelain surfaces should be cleaned and, if the connections are exposed, their tightness should be checked.

19.2.5 Cable identification tags or markings should be checked.

~~19.2.6 Because inspection intervals normally are one year or more, comprehensive records are an important part of any maintenance program. Comprehensive records should be arranged to facilitate comparison from year to year.~~

19.3 **Aerial Installations**. Aerial cable installations should be inspected for mechanical damage due to vibration, deteriorating supports, or suspension systems. Special attention should be given to the dead-end supports to ensure that the cable insulation is not abraded, pinched, or bent too sharply. Terminations should be inspected as covered in 19.2.2. Aerial cable installations should be inspected for animal and bird infestation.

19.4 Raceway Installations. Because the raceway is the primary mechanical support for the cable, it should be inspected for signs of deterioration or mechanical damage or if the cable jacket is being abraded or mechanically damaged. In many installations, the raceway serves as a part of the ground-fault current circuit. Joints should be inspected for signs of looseness or corrosion that could result in a high resistance. The recommendations for splices and terminations covered 19.2.2 also apply in this section.

19.5 **Electrical Testing**. ~~(See Chapter 11) The two most commonly used test for cable installation are installation-resistance testing and dc over-potential testing. Other tests are listed in ANSI/IEEE 400, Guide for Making High-Direct-Voltage Tests on Power Cable Systems in the Field.~~ When performing electrical testing of cables, one must take into account many factors before applying a specific test methodology. The most common electrical test performed on a power cable is insulation resistance. In many instances it may be desired to achieve a more comprehensive analysis of cable condition, doing so with techniques and methods other than insulation resistance. The various cable testing methods are covered in 11.21.

19.6 **Inspection and Testing Records**. Because inspection intervals normally are one year or more, comprehensive records are an important part of any maintenance program. Comprehensive records should be arranged to facilitate comparison from year to year.

Substantiation: Various sections of chapter 19 were updated to current industry terminology. Additionally editorial corrections to the current text have been made. Changes in chapter 19 point the reader to Chapter 11, Section 11.21 for further information related to cable testing.

Committee Meeting Action: Accept

Number Eligible to Vote: 15

Ballot Results: Affirmative: 14

Ballot Not Returned: 1 Wyman, B.

70B-73 Log #31 EEM-AAA **Final Action: Accept**
(21.14.2.2)

Note: This proposal appeared as Comment 70B-51 (Log #3) which was held from the Fall 2009 ROC on Proposal 70B-46.

Submitter: Stephen McCluer, Dallas, TX

Recommendation: Revise text to read as follows:

If used, pilot cell voltage specific gravity, and electrolyte temperature should be measured and recorded ~~monthly~~ per the established maintenance program (9.9.4.2). Refer to the manufacturer's recommended range for float voltage applicable to a specific battery. ~~Common float voltage range for lead-calcium cells is 2.20 volts to 2.30 volts per cell. Lead-antimony cells float at about 2.17 volts to 2.21 volts per cell. Ni-Cad cells charge at approximately 1.42 volts per cell. Manufacturers' literature should be referred to for specific charge potentials~~.

Substantiation: Pilot cell readings are optional and are primarily for lead-antimony batteries. Not all routines are monthly. There are 3 specific measurements mentioned in the statement. Only one has a range. The range given could be misleading depending upon the specific gravity. It would be better to refer to the manufacturer's recommendation for the specific battery.

This comment is the consensus of the IEEE Stationary Battery Code Working Group which includes the following members: Phylis Archer/ C&D Technologies; Curtis Ashton/ Qwest Communications; Gary Balash/ Deka Batteries ; Thomas Carpenter/ Arnold AFB; Allen Byrne / International Batteries; Daniel Levin / NYPA; Stephen McCluer/APC by Schneider Electric; Russell Miller/ Douglas Battery; John Polenz/ Emerson Electric; and Chris Searles/ BAE Batteries.

Committee Meeting Action: Accept

Number Eligible to Vote: 15

Ballot Results: Affirmative: 14

Ballot Not Returned: 1 Wyman, B.

70B-74 Log #32 EEM-AAA **Final Action: Accept**
(21.14.2.2)

Note: This proposal appeared as Comment 70B-52 (Log #51) which was held from the Fall 2009 ROC on Proposal 70B-46.

Submitter: Stephen McCluer, Rep. IEEE Stationary Battery Committee

Recommendation: Revise text to read as follows:

If used, pilot cell voltage specific gravity, and electrolyte temperature should be measured and recorded ~~monthly~~ per the established maintenance program (9.9.4.2). Refer to the manufacturer's recommended range for float voltage applicable to a specific battery. ~~Common float voltage range for lead-calcium cells is 2.20 volts to 2.30 volts per cell. Lead-antimony cells float at about 2.17 volts to 2.21 volts per cell. Ni-Cad cells charge at approximately 1.42 volts per cell. Manufacturers' literature should be referred to for specific charge potentials~~.

Substantiation: Pilot cell readings are optional and are primarily for lead-antimony batteries. Not all routines are monthly. There are 3 specific measurements mentioned in the statement. Only one has a range. The range given could be misleading depending upon the specific gravity. It would be better to refer to the manufacturer's recommendation for the specific battery.

This comment is the consensus of the IEEE Stationary Battery Code Working Group which includes the following members: Phylis Archer/ C&D Technologies; Curtis Ashton/ Qwest Communications; Gary Balash/ Deka Batteries ; Thomas Carpenter/ Arnold AFB; Allen Byrne / International Batteries; Daniel Levin / NYPA; Stephen McCluer/APC by Schneider Electric; Russell Miller/ Douglas Battery; John Polenz/ Emerson Electric; and Chris Searles/ BAE Batteries.

Committee Meeting Action: Accept

Number Eligible to Vote: 15

Ballot Results: Affirmative: 14

Ballot Not Returned: 1 Wyman, B.

70B-75 Log #33 EEM-AAA **Final Action: Accept**
(21.14.2.6)

Note: This proposal appeared as Comment 70B-59 (Log #2) which was held from the Fall 2009 ROC on Proposal 70B-46.

Submitter: Stephen McCluer, Dallas, TX

Recommendation: Revise text to read as follows:

~~Test readings~~ Measurements should be recorded for future reference along with log notations of the visual inspection and corrective action. ~~A copy~~ An example of a battery record is included as Figure F.21. The record should be modified to correspond to the user's maintenance program per 9.9.4.2.

Substantiation: The example given in F.21 is not applicable to all battery types. It is not applicable to capacity or performance testing. It applies to routine maintenance/ inspection and really should not be referenced in this testing section at all.

This comment is the consensus of the IEEE Stationary Battery Code Working Group which includes the following members: Phylis Archer/ C&D Technologies; Curtis Ashton/ Qwest Communications; Gary Balash/ Deka Batteries; Thomas Carpenter/ Arnold AFB; Allen Byrne / International Batteries; Daniel Levin / NYPA; Stephen McCluer/APC by Schneider Electric; Russell Miller/ Douglas Battery; John Polenz/ Emerson Electric; and Chris Searles/ BAE Batteries.

Committee Meeting Action: Accept

Number Eligible to Vote: 15

Ballot Results: Affirmative: 14

Ballot Not Returned: 1 Wyman, B.

70B-76 Log #34 EEM-AAA **Final Action: Accept**
(21.14.2.6)

Note: This proposal appeared as Comment 70B-60 (Log #55) which was held from the Fall 2009 ROC on Proposal 70B-46.

Submitter: Stephen McCluer, Rep. IEEE Stationary Battery Committee

Recommendation: Revise text to read as follows:

~~Test readings~~ Measurements should be recorded for future reference along with log notations of the visual inspection and corrective action. ~~A copy~~ An example of a battery record is included as Figure F.21. The record should be modified to correspond to the user's maintenance program per 9.9.4.2.

Substantiation: The example given in F.21 is not applicable to all battery types. It is not applicable to capacity or performance testing. It applies to routine maintenance/ inspection and really should not be referenced in this testing section at all.

This comment is the consensus of the IEEE Stationary Battery Code Working Group which includes the following members: Phylis Archer/ C&D Technologies; Curtis Ashton/ Qwest Communications; Gary Balash/ Deka Batteries; Thomas Carpenter/ Arnold AFB ; Allen Byrne / International Batteries; Daniel Levin / NYPA; Stephen McCluer/APC by Schneider Electric; Russell Miller/ Douglas Battery; John Polenz/ Emerson Electric; and Chris Searles/ BAE Batteries.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-77 Log #CP2 EEM-AAA **Final Action: Accept**
(23.5.1 (New))

Submitter: Technical Committee on Electrical Equipment Maintenance,
Recommendation: Add new text to read as follows:
23.5.1 Efficiency requirements influence the need to replace entire light fixtures or selected components (e.g. ballasts, lamps) during maintenance procedures. The U.S. Government Energy Star program provides identification of products meeting these energy efficiency requirements.
Renumber existing 23.5.1-23.5.2
Substantiation: The committee recognizes the need to improve efficiency in lighting and compliance requirements with Energy Independence and Securities Act of 2007.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-78 Log #CP3 EEM-AAA **Final Action: Accept**
(23.5.3 (New))

TCC Action: The Technical Correlating Committee directs that the committee revise the text to remove the mandatory word "must" which is not allowed in a recommended practice by Section 2.4.1.3 of the NFPA Manual of Style. The Technical Correlating Committee also directs that 23.5.3.1.2 be re-written to form a complete sentence. The Technical Correlating Committee further directs that Section 23.5.3.1.3 be re-written to form complete sentences and replace the term "lamp fixture" with the term "luminaire." This shall be considered as a public comment.
Submitter: Technical Committee on Electrical Equipment Maintenance,
Recommendation: Add new section 23.5.3 LED Lamps.
23.5.3 **Light Emitting Diode (LED) Lamps**. An LED lamp consists of an array of LEDs as the light source, which may include semiconductor, organic or polymer LEDs.
23.5.3.1 **Relamping fixtures with LED lamps**.
23.5.3.1.1 **Two common approaches to relamping with LEDs**:
(1) A direct lamp replacement which does not involve any rewiring or changes in the luminaire other than replacement of the existing lamp, such as replacing an incandescent lamp with a more energy efficient LED lamp. It is important to look for the Listing mark and follow the use markings for the correct application of the replacement lamp.
(2) A luminaire conversion using a Retrofit Luminaire Conversion Kit. These kits generally involve replacing the lamp, rewiring the luminaire and, in some cases, replacing parts such as a ballast with an LED power supply or directly connecting the lamp to the supply circuit.
23.5.3.1.2 Disconnected electrical power to the entire fixture should be when servicing a fixture for any reason.
23.5.3.1.3 In some lamp fixtures, electronic ballasts must be removed and the wiring must be reconnected directly to the end sockets. Refer to Figure 23.5.3.1. Refer to Figure 23.5.3.2 for older fixtures with a magnetic ballast and starter require removal or opening of the starter circuit and removal or bypassing the ballast.

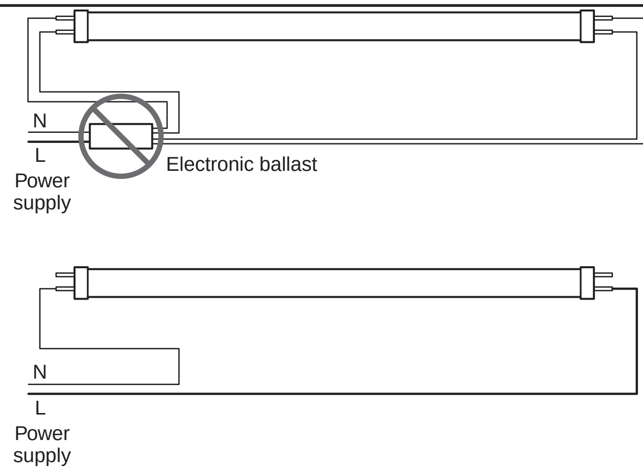

Figure 23.5.3.1 Example of Removal of Electronic Ballast and the Wiring Reconnection for Retrofit of Luminary for LED Lamps

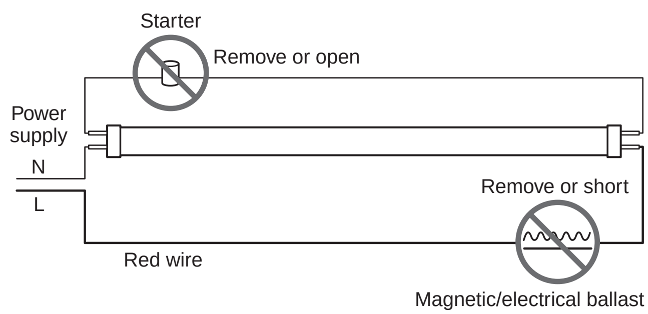

Figure 23.5.3.2 Example of Removal of Magnetic Ballast and Starter with the Wiring Reconnection for Retrofit of Luminary for LED Lamps

23.5.3.1.4 Retrofit luminaire conversion kits selected for use should be evaluated by a testing organization to confirm that the kits, when installed into the identified luminaires in accordance with the installation instructions included with the kit, will result in a luminaire that continues to comply with safety requirements. It is important for installers and luminaire maintenance personnel when installing a retrofit luminaire conversion kit to note the following essential safety elements:

(1) Before installation, a thorough review of the luminaire and the kit installation instructions is necessary to verify that the retrofit kit is appropriate for the luminaire.

(2) Review and follow the instructions for preparation of the existing luminaire prior to installation of the kit and note all warnings and other instructions with respect to kit limitations.

23.5.3.1.5 Use only the exact replacement parts provided with the kit or reuse existing luminaire parts if specifically directed to by the kit installation instructions.

23.5.3.1.6 Lamp replacement directions must be followed to avoid risk of fire or electric shock hazard.

(1). Where replaceable LED lamps are used in a converted luminaire it is important to follow the markings added to the luminaire describing the exact replacement lamps that must be used for proper operation.

(2). Use of anything other than the exact replacement lamp specified for the converted luminaire could pose a risk of shock or fire when installed in the luminaire.

(3). Follow the instructions for insertion of replacement lamps since orientation and specific polarity may be required for the luminaire to properly operate.

23.5.3.2. Retrofitting fluorescent luminaries with LED lamps

23.5.3.2.1 Special considerations must be given when retrofitting fluorescent luminaries that have bi-pin lampholders that are being reused.

23.5.3.2.2 A retrofit kit cannot be installed in luminaires employing shunted bi-pin lampholders when the retrofit kit instructions specify that line and neutral power are to be connected to the same lampholder, since this may result in a potential fire or electric shock hazard. Contact the LED luminaire retrofit kit manufacturer when in doubt about the compatibility of the kit and the lamp fixture.

23.5.3.2.3 Push-in terminals of existing fluorescent lampholders are not intended to have wires removed and reinstalled. If rewiring and/or connections to existing fluorescent lampholders are indicated by the installation instructions, the connections may be made by splicing the lampholder leads using an appropriate splicing means using Listed connectors.

Substantiation: Newer lighting technologies that are more efficient are available. LED Lamps are one such technology whose use in increasing. In particular, retrofitting existing luminaires with such needed to be addressed.

Committee Meeting Action: Accept

Number Eligible to Vote: 15

Ballot Results: Affirmative: 14

Ballot Not Returned: 1 Wyman, B.

70B-79 Log #CP5 EEM-AAA **Final Action: Accept**

(Chapter 29)

Submitter: Technical Committee on Electrical Equipment Maintenance,

Recommendation: Revise Chapter 29 as follows:

Chapter 29 Portable Electrical Tools and Equipment

29.1 **Introduction.**

29.1.1 Dependable performance and long service life of power tools is becoming more important as the need for mechanization and the use of power tools increase. A plant's entire inventory of portable tools can be kept in top operating condition for maximum production quality and cost efficiency with planned routine and periodic inspection.

29.1.2 There are many and varied types of portable power tools and many and varied causes of power tool failure. Therefore, the procedures for their maintenance can be general recommendations only. Variations exist and depend on the type of tool and the particular conditions of its use. ~~It is strongly recommended that the i~~Information on proper use and maintenance given in the tool manufacturer's use and care manual, supplied with each tool, should be carefully followed.

29.1.3 Periodic electrical testing will uncover many operating defects, and their immediate correction will ensure safe operation and prevent breakdown and more costly repairs. This testing and the related maintenance should be systematic. ~~A visual inspection is recommended before and after each use; when the tool is issued and again when it is returned to the tool crib.~~ Tools should be visually inspected for damage and defects before and after each use.

29.1.4 Use tools only for their intended purpose.

29.1.5 Use the personal protective equipment necessary when using tools to protect from the hazards of falling, flying, abrasive and splashing objects and from harmful dusts, fumes, mists, vapors or gases. 29.1.6 Defective tools should immediately be tagged, removed from service, and reported.

29.2 **Employee Training**

29.2.1 Employee training in the proper care and use of portable power tools is an important part of preventive maintenance. Employees should be given instructions in selecting the proper tool for the job and the limitations of the tool. Using an underpowered tool for the work load can cause overloading. Employee training in the proper care and use of portable power tools is an important part of preventive maintenance. Employees should be given instructions in selecting the proper tool for the job and the limitations of the tool. Using an underpowered tool for the work load can cause overloading.

29.2.2 Employees should be trained to recognize obvious defects such as cut, frayed, spliced or broken cords; cracked or broken attachment plugs and missing or deformed grounding prongs. Such defects should be reported immediately.

29.2.3 Employees should be instructed to report all shocks immediately, no matter how minor, and to cease using the tool. Tools that cause shocks should be examined and repaired before further use.

29.3 **Tool Maintenance**. The maintenance procedures in 29.3.1 through 29.3.3.2 are general recommendations. The best source for maintenance information is the original manufacturer.

29.3.1 **Periodic Inspection of Crucial Wear Points**. Brushes and commutators should be inspected periodically. This is easily accomplished by removal of brush-holder plugs or inspection plates, depending on the construction of the tool. Brushes worn down to 50 percent of their original size should be replaced. When a brush is replaced, always be sure to use the manufacturer's original equipment.

29.3.2 **Excessive Dirt Accumulation**. All universal motors are fan ventilated to prevent excessive heat. Even though many tools have filters and deflectors to prevent destructive material from damaging the motor, a small amount of it will pass through. Excessive buildup affects the brush operation and reduces the air volume necessary to cool the motor. When necessary, the tool should be blown out with low-pressure, dry-compressed air when used in a normal environment. More frequent specialized maintenance should be considered if the atmosphere is heavy in abrasives or conducting dusts.

29.3.3 **Insufficient or Improper Lubrication**. Lubricant inspection is recommended at frequent intervals to ensure sufficient lubricant to prevent wear to mechanical parts. Dirty lubricants should be removed and replaced. Because lubricant varies from tool to tool, it is recommended that proper lubricant be obtained from the manufacturer or the manufacturer's distribution outlet.

29.3.3.1 **Lubricants**. Manufacturers carefully match lubricants to be compatible with speeds, heat, seals, bearings, and pressure to ensure long gear and mechanism life. Substitutions can damage the tool and invalidate the warranty.

29.3.3.2 The wrong amount of lubricant can cause serious problems. Too little means that surfaces are not adequately covered and excess wear will result. Too much lubricant can cause excess pressure in the gear case and eventually ruins seals.

29.4 **Cord and Attachment Plug Care**.

29.4.1 The cord of an electric power tool is the lifeline It should be kept free of oil, grease, and other material that might ruin the rubber cover. Tangling knots or dragging across sharp surfaces should be avoided. The cord should not be used as a towline to carry or drag the tool.

29.4.2 All power tools, unless they are double insulated and so marked, are required to be grounded through an additional grounding conductor in the cord and the grounding prong of the attachment plug. The integrity of this grounding circuit is necessary for the protection of life and should be inspected visually before each use. Experience has shown that the grounding prongs of attachment caps are frequently cut off for use in ungrounded receptacles. This practice should not be permitted.

29.4.3 If a cord is cut, broken, spliced, or frayed; the attachment plug is damaged; or the grounding prong is removed, it should be immediately withdrawn from service until it can be repaired. Cords can be replaced in their entirety, or a damaged cord can be repaired by cutting out the damaged portion and applying a plug and connector to rejoin the two sections. Replacement cords should be of the same type and conductor size and suitable for use.

29.4.4 To avoid accidents, the green insulated conductor is to be used only for connecting the frame of the tool to the equipment-grounding terminal of the attachment plug meeting the conditions of NFPA 70, National Electrical Code, Section 400.24. It should not be used for any other purpose.

29.4.5 Flexible cords and cables should be protected from damage. Contact with sharp corners and projections should be avoided.

29.5 **Extension Cords**.

29.5.1 Before placing extension cords in service, the plug and connector should be checked for proper polarity, and the grounding conductor should be tested for continuity and integrity. Extension cords of the proper conductor size should be used to avoid excessive voltage drop that might result in poor operation and possible damage to the tool. Table 29.5 lists the recommended sizes of extension cords.

29.5.2 Only extension cords with an equipment grounding conductor should be used.

29.5.3 Extension cords should be protected from damage, and not run through doorways or windows where the doors or windows may close, causing damage to the cord.

29.6 **Major Overhauls**. Major overhauls and repairs should be performed by the manufacturer; however, large companies that use power tools and who prefer to do their own repairs and overhaul should obtain the necessary parts, schematics, connection diagrams, lubricant charts, and other technical information from the manufacturer.

29.7 **Leakage Current Testing**. Portable and cord-connected equipment should be tested periodically for the amount of leakage current present to help ensure against shock hazards

Substantiation: The committee revised Chapter 29 to improve the readability of the document as well as to provide additional safety practices specific to portable electrical tools.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-80 Log #CP18 EEM-AAA **Final Action: Accept**
(Chapter 32 (New) and 6.9.3 (Deleted))

Submitter: Technical Committee on Electrical Equipment Maintenance,
Recommendation: Add a new Chapter 32 and delete 6.9.3 except for title directing to new Chapter 32:

Chapter 32 Electrical Disaster Recovery

32.1 Introduction.

When industrial facilities are faced with a catastrophic event such as a fire, flooding, hurricane, tornado, earthquake or similar disaster, a very specific and detailed sequence of events must occur to return the facility to productive operation in a safe and expeditious manner.

To accomplish this after a disaster event, it is especially critical to analyze and repair the *electrical power system* in a safe and logical sequence. This chapter describes the recovery steps for an electrical power system and related equipment that should be followed after an electrical disaster event occurs.

32.2 Catastrophic event categories.

The events surrounding a disaster can be detailed into specific event phases, categorized as:

32.2.1 The initial event. Disaster recovery efforts can be a result of fire, flooding, hurricane, tornados, and earthquakes. Disaster scenarios inflict damage of varying degrees to facilities such as but not limited to a result of the following:

(1) Fire: soot, material and equipment damage, water damage, structural damage.

(2) Flooding: water damage, structural damage.

(3) Hurricane: water damage, structural damage, utility infrastructure damage.

(4) Tornado: water damage, structural damage, utility infrastructure damage.

(5) Earthquake: structural damage, utility infrastructure damage.

32.2.2 Securing the facility to limit damage. If possible, a facility should be secured prior to the disaster event to limit electrical and mechanical damage to equipment and systems. Electrical and mechanical systems should be shut down and secured, and critical components should be removed or preserved. Examples of tasks to limit damage:

(1) Remove critical motors from their base and raise them above the flood line

(2) De-energize power to prevent electrical short circuit and arcing damage.

(3) Secure storage tanks and other large devices that may float away.

(4) Sandbag the fronts of electrical equipment rooms to limit water and debris entry.

(5) Remove critical computer and electronic equipment from the site.

(6) Remove all electrical equipment and supplies stored at ground level.

32.2.3 Mobilization of recovery personnel. During large-scale disaster events one of the biggest challenges for a commercial or industrial facility is providing enough qualified contractors and disaster recovery specialists to perform required remediation to the facility. Prior to a disaster event occurring, a preplan should be developed for the mobilization of recovery personnel.

32.2.3.1 In-house personnel. Before a disaster event occurs responsible personnel for the disaster recovery operations and facility repair should be designated and have possession of any applicable action plans. Depending on the magnitude of the event the recovery effort may be done solely with in-house personnel or with the assistance of professional restoration companies.

32.2.3.2 Outsourced (contract) personnel. Prior to a disaster event facilities should have considered establishing Master Service Agreements (MSA's) with multiple qualified vendors who specialize in electrical disaster recovery services. Doing so prevents confusion and delays in the recovery efforts. Decide who will perform the cleanup (debris removal and electrical equipment restoration) and supply support equipment (such as flood pumps, heavy equipment and operators, emergency power equipment, temporary electrical services). Qualified repair facilities should be identified prior to a disaster recovery event.

32.2.3.3 Notification to insurance carrier. As soon as feasible the site insurance carrier's claims representative should be notified of the event.

32.2.4 Developing a safety plan. A site specific safety plan should be developed before a disaster occurs. When performing recovery of electrical equipment, safety, environmental and health are paramount. Lockout/tagout, test before touch, and the application of safety grounds are typically covered in site electrical safety plans. While these are key safety aspects of placing equipment into an electrically-safe condition, there are other items of safety that need to be addressed and integrated into the safety plan such as:

(1) Air quality.

(2) Structural issues.

(3) Chemical spill exposure.

(4) Site-specific hazards.

(5) Site-specific PPE requirements

32.2.5 Temporary and emergency power generation. When disaster events occur often times there is a loss of normal utility power. This creates a unique safety and logistical challenge to provide the required electrical power in a facility for critical systems and lighting.

If the temporary power portion of the project is managed properly, the risk of accidental shock and burn can be drastically reduced. There should be dedicated personnel responsible for temporary power and they should develop all written standards and procedures to be followed. Typical emergency power procedures should identify elements such as:

(1) Backfeeding of equipment.
(2) Individual motor starters for pumps.
(3) Temporary signage and barricades.
(4) Site generator location maps.
(5) Fueling schedules.
(6) Written form for the addition of electrical power.
(7) Access and exhaust flow.

32.2.6 Initial damage assessment. One of the first tasks in assessing equipment and system damage to electrical equipment involved in a disaster event is to gather all pertinent drawings and documentation available and perform a walkthrough and initial assessment of the entire electrical infrastructure.

32.2.6.1 Drawings, schematics, equipment documentation. In some instances drawings and documentation are not available due to destruction from the disaster event. All equipment instruction books, O&M manuals, and documentation should be identified and centrally located.

32.2.6.2 Priority assessment. Equipment repair priorities should be assessed with a focus on the highest priority equipment. Examples of typical equipment categories are:

(1) Category 1 Medium-voltage equipment including distribution transformers.
(2) Category 2 Low-voltage distribution equipment.
(3) Category 3 Electric motors.
(4) Category 4 Balance of the plant.

32.2.7 Documentation. All electrical components or equipment should be properly documented prior to removal to ensure the equipment is reinstalled properly. The documentation process includes:

(1) Tag each piece of equipment.
(2) Label all control and power wires.
(3) Take a digital picture of each piece of equipment.
(4) Sketch an accurate diagram of each piece of equipment on the electrical equipment drawing sheet.
(5) Fill out the electrical equipment tracking form.
(6) Save all pictures on a local database.
(7) File the electrical equipment drawing sheet.

(8) Create a master electrical equipment tracking document.
(9) Shipping documents of all electrical equipment.

32.2.7.1 Service shop activities. If equipment is to be removed from the affected facility for repair at an offsite service center the equipment should be tagged, identified, tracked, and status updated on a master equipment repair database.

32.2.7.2 Equipment tag. Information on each tag should include a unique sequence number, plant identification number, plant description, date, power center or room number. The tag should be filled out with a medium point permanent marker so the information is legible. The tag should be attached to the equipment with a secure plastic wire tie.

32.2.7.3 Labeling of wires. All control wires should be labeled with wire numbers and the power wires with colored phasing tape. Make sure that each side of the termination, both wire and connected device, is identified. This will ensure the wiring will be re-connected as it was originally installed.

32.2.7.4 Photographs of equipment. After the equipment is tagged and the wires are labeled, a minimum of three photographs should be taken of each piece of equipment. The first photo should include the equipment tag in the picture, making sure the tag is legible and the picture is clear. The second photo is an overall view for the sole purpose of wire clarification/documentation during the reinstallation process and should include all wiring associated with the applicable device. The third photograph should be of the equipment nameplate. Additional photographs should be taken as deemed appropriate.

32.2.7.5 Field sketch. An accurate field sketch of the electrical equipment should be generated. The sketch should be recorded on a site specific electrical equipment drawing sheet template. This drawing sheet should include the job name, job number, power center, sequence number, plant equipment number, plant description, technician name, date and enough room to sketch the piece of equipment.

32.2.7.6 Equipment tracking sheet. After a sketch is made of the piece of equipment the equipment should be added to an electrical equipment tracking sheet. The electrical equipment tracking sheet should be customized and detailed. The tracking sheet should include general information such as overall condition, item number, sequence number, priority, area of the plant, power center or room number, transformer, substation, cell position, equipment type, circuit identification, plant identification number, manufacturer, percent water level, model number, frame size and voltage.

Field tracking information should also include date documented, date pulled, date shipped, date returned, date installed and any dates that quality assurance procedures were performed.

32.2.7.7 Repair or replace. During the documentation process, initial decisions should be made pertaining to each piece of equipment that is damaged. Seeking the services of qualified equipment assessment personnel, whether manufacturer representatives or subject matter experts, is important in the decision making process.

32.2.7.7.1 Repair or replace decisions. Many factors can affect the repair/replace decision. Some of the likely decisions are:

(1) Can the equipment be repaired or does the equipment need to be replaced?
(2) Can the repairs take place on site or does the equipment need to be sent to a repair facility?

32.2.7.7.2 Repair or replace factors. Some of the factors that may affect the repair or replace decision:

(1) Is the equipment currently manufactured?
(2) Are there long lead times to replace with new?
(3) Will equipment performance be compromised if repaired?
(4) What is the age of the equipment?
(5) What is the reliability requirement?
(6) Can it be effectively repaired?
(7) Is the manufacturer still in business?
(8) Is the repair contractor qualified for the task?
(9) Will the AHJ allow repair or replacement?
(10) What is the financial impact?
(11) What is the total outage time required?

32.2.8 Industry standards and guidelines. Industry standards and guidelines should be referred to for information. Information is available from:

(1) Electrical Apparatus Service Association (EASA)
ANSI/EASA AR100, *Recommended Practice for the Repair of Rotating Electrical Apparatus*

(2) Federal Emergency Management Agency (FEMA)
FEMA P-348, *Protecting Building Utilities From Flood Damage; Principles and Practices for the Design and Construction of Flood Resistant Building Utility Systems*

(3) Institute of Electrical and Electronic Engineers (IEEE)
IEEE Std. 3007.2, *Recommended Practice for the Maintenance of Industrial and Commercial Power Systems*

(4) National Electrical Manufacturers Association (NEMA)
NEMA *Guidelines for Handling Water-Damaged Electrical Equipment*

(5) InterNational Electrical Testing Association (NETA)
ANSI/NETA Acceptance Testing Specification, *Standard for Maintenance Testing Specifications for Electrical Power Distribution Equipment and Systems*

(6) National Fire Protection Association (NFPA)

NFPA 70, *National Electrical Code*

NFPA 70E, *Standard for Electrical Safety in the Workplace*

(7) PowerTest Annual Technical Conference, 2009

Flood Repair of Electrical Equipment; March 12, 2009, Pat Beisert, Shermco Industries

32.2.9 Medium-voltage equipment. Medium-voltage equipment typically serves as the backbone to the electrical power system and should be the primary focus of the initial recovery activities.

32.2.10 Low-voltage distribution equipment. Affected components of low-voltage equipment should be removed to facilitate cleaning and drying of the structures. During the removal of the equipment care should be taken to keep all wiring for each component well marked and together.

32.2.11 Electric motors. When a disaster event involves water, electric motor repair is a major component of a flood recovery project. The documentation process is very similar to other electrical equipment but there are additional items that should be documented. The documentation process should include:

(1) Nameplate data and location of the motor.
(2) Tag the motor base and the motor with a unique sequence number.
(3) Mark and record electrical connections.
(4) Record coupling information and condition of coupling.
(5) Mark and record shim information.
(6) Collect all mounting hardware, couplings, shims and store in its own labeled container. This equipment stays on site and should be stored in a central location.

32.2.12 Power and control wiring. Power and control wiring should be tested to determine serviceability. See 11.21 *Cables*.

32.2.13 Balance of plant electrical repair. Balance of plant consists of all equipment other than medium-voltage equipment, low-voltage distribution equipment and motors. This includes items such as receptacles, light switches, lighting transformers, panelboards, start-stop stations, fire alarm panels, instrumentation and process control components, and metering. These devices are typically repaired by replacement.

32.2.14 Re-energization of the facility. Initial re-energization to utility power of a facility damaged by a disaster event should be carefully planned and methodically implemented. To reduce the possibility of accidental energization of equipment it may be prudent to forego any utility energization until all affected equipment has been repaired or replaced.

32.2.15 System commissioning. After re-energization of the facility the equipment operation and performance should be verified. See Chapter 31, *EPM from Commissioning (Acceptance Testing) Through Maintenance* and Figure H.35 in Annex H. A period of monitoring should be established to verify and document proper operation has been restored.

32.2.16 Project summary. After a disaster recovery event there is information gathered that should be available for future reference. The final project report should contain this data and should include information such as:
(1) As found conditions of the electrical infrastructure.

(2) Listing of equipment repaired or replaced.

(3) Test results of all equipment tested.

(4) Assessment of individual equipment condition.

(5) Long-term equipment replacement plan.

6.9.3 Procedure for Post-Emergency Actions. - See Chapter 32 Disaster Recovery.

~~**6.9.3.1** An evaluation should be conducted by persons qualified for determining the condition of the equipment and any damage that would preclude re-energization of electrical systems.~~

~~**6.9.3.2** Process for restoration of electrical systems and equipment.~~

~~(1) Proper safety procedures should be determined and Personal Protection Equipment (PPE) utilized before commencing restoration of the electrical systems and equipment.~~

~~(2) Visual inspection for any contaminants and/or physical damage.~~

~~(3) Where no damage is observed, next determine the electrical integrity of equipment by conducting applicable testing, such as continuity testing and insulation resistance.~~

~~(4) Where equipment is damaged or has failed electrical integrity test(s), then determine which of following are applicable, factoring in the time and criticality of getting the equipment back in service:~~

~~(a) An appropriate, expedient repair, such as simply removing debris and other contaminants in the area and/or equipment without compromising safe operation of the equipment.~~

~~(b) Repair per manufacturer's instructions.~~

~~(c) Locate replacement equipment and properly replace in accordance with manufacturer's instructions.~~

~~(5) Where equipment passes electrical integrity testing, a qualified person evaluates the risk of re-energizing electrical cables, panelboards, switchboards and switchgear.~~

~~Data should be compared against baseline and recent maintenance test data.~~

~~(6) Where the risk is determined to be acceptable, proceed to system level testing, such as detailed in Figure H.35 in Annex H.~~

~~(7) Once the system has been re-energized, a period of monitoring should be established providing confidence levels in the restored system and/or equipment~~

Substantiation: A more detailed coverage of the maintenance tasks related to pre- and post-emergency actions is covered in this proposal. A less comprehensive coverage of the maintenance tasks was previously covered in Chapter 6.9.3, which has been deleted in this proposal. All of those original concepts are included here in more detail, as well as additional relevant materials.

Committee Meeting Action: Accept

Number Eligible to Vote: 15

Ballot Results: Affirmative: 14

Ballot Not Returned: 1 Wyman, B.

Comment on Affirmative:

WHITE, J.: This newly-expanded section provides added guidance on disaster recovery, which has been shown to be a critical component in resuming production and re-establishing a safe work place.

70B-81 Log #CP22 EEM-AAA **Final Action: Accept**
(Chapter 33 (New))

Submitter: Technical Committee on Electrical Equipment Maintenance,

Recommendation: Add a new Chapter 33 to read as follows:

Chapter 33 Photovoltaic Systems.

33.1 Introduction

33.1.1 A solar photovoltaic electrical energy system is a renewable source of energy. The major electrical system components include the array circuit(s), inverter(s), and controller(s). The arrays are generally found mounted either on a roof or on supports in a ground mounted array. Photovoltaic systems may be interactive with other electrical power production sources or standalone, with or without electrical energy storage such as batteries.

33.1.2 The maintenance program should be planned at the time the system is installed in order to ensure the greatest level of safety to the maintenance worker and the highest level of efficiency can be obtained from the operation of the system.

33.1.3 The elements of the weather and climate changes can have a significant impact on the photovoltaic system and attention should be given to the system after significant weather or environmental events.

33.1.4 Photovoltaic system typically generate voltages in the 400 to 1000Vdc range. Only qualified persons should perform maintenance on photovoltaic systems due to the unique hazards associated with the arrays always producing electrical energy.

33.2 Maintenance of the Photovoltaic System.

33.2.1 A newly installed photovoltaic system should include supporting documentation which should include specifications, electrical schematics, mechanical drawings and a material list.

33.2.2 Development of a comprehensive maintenance plan should include:

a) energy monitoring,

b) visual inspection,

c) array cleaning,

d) emergency response

33.2.3 The visual inspection of the array should include:

a) wiring and terminations

b) wiring harness secureness

c) array cleanliness, absences of damage and structural integrity

d) roof penetrations and weather sealing

e) inverters, switches and combiner boxes

f) batteries

33.3 Markings and Labeling.

33.3.1 Identification and location of roof top panels on the building with proper signage should be installed prior to completion installation. Marking is needed to provide appropriate warning and guidance with respect to working around and isolating the solar electric system. This can facilitate identifying energized electrical lines that connect the solar modules to the inverter.

Substantiation: Photovoltaic systems are installed at industrial, commercial, institutional, and municipal facilities. Although maintenance recommendations for some of the equipment associated with PV systems are covered by other chapters of NFPA 70B, there are also maintenance considerations unique to the modules, arrays, and other PV system equipment that necessitate inclusion of this new chapter in Chapter 33 Photovoltaic Systems

Committee Meeting Action: Accept

Number Eligible to Vote: 15

Ballot Results: Affirmative: 14

Ballot Not Returned: 1 Wyman, B.

Comment on Affirmative:

BINGHAM, R.: A prior paragraph in this section indicates system may or not have batteries. 33.3.2 f should read "batteries (where applicable)".

WHITE, J.: The addition of the photovoltaic generation systems chapter is badly needed to provide guidance in a newly-forming industry.

70B-82 Log #CP23 EEM-AAA **Final Action: Accept**
(Chapter 34 (New))

Submitter: Technical Committee on Electrical Equipment Maintenance,

Recommendation: Add a new Chapter 34 to read as follows:

Chapter 34 Electric Vehicle Charging Systems

34.1 Introduction

34.1.1 Electric vehicles require the installation and maintenance of electrical infrastructure which include the electrical conductors and equipment external to an electric vehicle that connect an electric vehicle to a supply of electricity by conductive or inductive means, and the equipment and devices related to electric vehicle charging.

34.1.2 Businesses, building owners and municipalities should include a maintenance program when an electric vehicle charging is installed. The maintenance program should be planned at the time the system is installed in order to ensure the greatest level of safety to the maintenance worker and the highest level of reliability and safety to the user of the vehicle charging station.

34.1.3 The elements of the weather, climate change, or physical impact on system components can have a significant impact on the electric vehicle charging station and attention should be given to the system after a significant weather or environmental events, or physical impact.

34.1.4 Electric vehicle charging systems typically are supplied by 240 or 480 V systems. Only qualified persons should perform maintenance on electric vehicle charging systems due to the unique hazards associated with the unique controls and potential hazardous level of energy provided at this point on the system.

34.2 Maintenance of the Electric Vehicle Charging Stations.

34.2.1 An installed electric vehicle charging system should included supporting documentation, specifications, electrical schematics, mechanical drawings and a material list.

34.2.2 Electric vehicle charging system cords should be inspected on a periodic basis to identify damage. Cord damage can result from physical impact or environmental degradation. A damaged cord should be replaced immediately.

34.2.3 Electric vehicle charging system connectors should be inspected on a periodic basis to identify damage. The connection to the car serves a significant safety role by ensuring a good electrical connection. A damaged connector should be replaced immediately.

34.2.4 Electric vehicle supply equipment (EVSE) should be inspected on a periodic basis to identify damage. The cord connection to the EVSE should be inspected on a periodic basis to verify that the strain relief is intact and stress is not placed on the cord terminations in the EVSE. Damaged should be addressed immediately.

34.2.5 The mounting of the electric vehicle supply equipment (EVSE) should be inspected on a periodic basis to ensure the integrity of the mounting means.

Substantiation: Electric vehicle supply equipment (EVSE) is being installed at commercial, institutional, and municipal facilities. Use of the charging equipment by customers and employees of these facilities on a regular basis necessitates a fundamental maintenance program to ensure that they can safely interface with the charging equipment. The committee encourages public comment on this proposal in order to ensure this new chapter meets the needs of those responsible for the safe use of this equipment.

Committee Meeting Action: Accept

Number Eligible to Vote: 15

Ballot Results: Affirmative: 14

Ballot Not Returned: 1 Wyman, B.

Comment on Affirmative:
WHITE, J.: The addition of the electric vehicle systems chapter is badly needed to provide guidance in a newly-forming industry.

70B-83 Log #CP24 EEM-AAA **Final Action: Accept**
(Chapter 35 (New))

Submitter: Technical Committee on Electrical Equipment Maintenance,
Recommendation: Add new Chapter 35 to read as follows:
Chapter 35 Wind Power Electric Systems and Associated Equipment
35.1 Introduction
35.1.1 The electrical equipment associated with wind power electric systems requires maintenance attention that may be more frequent than other installations due to the nature of these installations. Environmental conditions are often very severe, vibration and temperature variations can affect the safety of these installations. Many different designs are used and the technology is constantly changing.
35.1.2 This service should be undertaken by trained and qualified workers and all electrical safety practices outlined in NFPA 70E need to be referenced and used.
35.2 Towers and Foundations
35.2.1 Check tower grounding connections, cables and grounding electrode resistance, see Section 14.3.
35.2.2 Check tower top electrical equipment, including navigational warning lighting, weather measurement devices.
35.2.3 Special attention should be paid to lightning protection components and their associated wiring systems. See NFPA 780 for guidance in testing and maintenance of these systems.
35.3 Yaw systems. Check electrical components and wiring for signs of damage or overheating.
35.4 Generators. See Chapter 25, Sections 1-9
35.5 Pitch systems. Check electrical components and wiring for signs of damage or overheating.
35.6 Instrumentation and Controls. Perform operational checks to ensure systems for emergency and safety shut-down are functional.
35.7 Supervisory Control and Data Acquisition System (SCADA) Perform connection and data transfer test to ensure operation.
35.8 Transformers and Converters. Perform electrical inspections as specified in Chapter 21 for transformers and Chapter 22 for converters.
35.9 Circuit Breakers. Perform electrical inspections as specified in Chapter 17 for circuit breakers**.**
35.10 Cable Support Systems, Cables and Terminations. Inspect cable support systems, terminations, and cables for damage due to vibration. See Section 19.2 for visual inspection, Terminations should be inspected as covered in Section 19.2.2 and tested per recommendations in Section 19.5.
35.11 Collector Substations and Switchgear. Perform electrical inspections as specified in Chapter 15 for collector substations and switchgear**.**
35.12 Associated Electrical Equipment
35.12.1 Check station power distribution panels for loose connections
35.12.2 Check fire alarm and emergency lighting systems for correct operation and loose connections.
35.12.3 Check motor control centers. See Sections 16.3, 16.4, and 16.7.
Substantiation: Wind power electric systems are installed at industrial, commercial, institutional, and municipal facilities. Although maintenance recommendations for some of the equipment associated with wind power systems are covered by other chapters of NFPA 70B, there are also maintenance considerations unique to the turbines, towers and other wind power system equipment that necessitate inclusion of this new chapter in NFPA 70B in order to ensure the ongoing safe operation of these systems. The committee encourages public comment on this proposal in order to ensure this new chapter meets the needs of those responsible for the safe use of this equipment.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.
Comment on Affirmative:
WHITE, J.: The addition of the wind generation systems chapter is badly needed to provide guidance in a newly-forming industry

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70B-84 Log #CP12 EEM-AAA **Final Action: Accept**
(Annex C)

Submitter: Technical Committee on Electrical Equipment Maintenance,
Recommendation: The only intended revisions to Annex C are the underlines and the strike-throughs:
C.1.3.1 American Association of Textile Chemists and Colorists (AATCC). P.O. Box 12215, Research Triangle Park, NC 27709.
ANSI/AATCC-27, *Wetting Agents: Evaluation of Rewetting Agents,* ~~1994~~ 2009.
C.1.3.2 American National Standards Institute, Inc. (ANSI). 25 West 43rd Street, 4th Floor, New York, NY 10036.
ANSI C2, *National Electrical Safety Code*, Part 1, Rules for the Installation and Maintenance of Electric Supply Stations and Equipment, ~~1993~~ 2007.
C.1.3.3 American Petroleum Institute (API). 1220 L St. NW, Washington, DC 20005-4070.
Guide for Inspection of Refinery Equipment, Chapter XIV, Electrical Systems.
C.1.3.4 American Society for Testing and Materials (ASTM International). 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.
ASTM D 120, *Standard Specifications for Rubber Insulating Gloves*, ~~1995~~ 2009.
ANSI/ASTM D 664, *Standard Test Method for Acid Number of Petroleum Products by Potentiometric Titration,* ~~1995~~ 2011.
ASTM D 1048, *Standard Specification for Rubber Insulating Blankets,* ~~1999~~ 2011.
ASTM D 1049, *Standard Specification for Rubber Insulating Covers*, 1998 ~~(E1-1995)~~ (R2010).
ASTM D 1050, *Standard Specification for Rubber Insulating Line Hose*, ~~1990~~ (E1 2005) ~~(R-1999)~~
ASTM D 1051, *Standard Specification for Rubber Insulating Sleeves*, ~~1995~~ 2008.
C.1.3.5 Crouse-Hinds. P.O. Box 4999, Syracuse, NY 13221.
Crouse-Hinds Code Digest, *Suggestions for Installation and Maintenance of Electrical Equipment for Use in Hazardous Areas,* ~~1996~~ 2011.
C.1.3.6 Factory Mutual Engineering Corporation. 1151 Boston- Providence Turnpike, Norwood, MA 02061.
Handbook of Industrial Loss Prevention, Chapter 32. 1968
C.1.3.7 Institute of Electrical and Electronics Engineers (IEEE). 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331.
~~ANSI/IEEE 56, *Guide for Insulation Maintenance of Large AC Rotating Machinery (10,000 kVA and Larger),* 1977 (Reaff. 1991).~~
ANSI/IEEE 67, *Guide for Operation and Maintenance of Turbine Generators,* ~~1990~~ 2005.
ANSI/IEEE 80, *Guide for Safety in AC Substation Grounding,* 2000.
ANSI/IEEE 141, *Recommended Practice for Electric Power Distribution for Industrial Plants* (Red Book), 1993.
ANSI/IEEE 142, *Recommended Practice for Grounding of Industrial and Commercial Power Systems* (Green Book), 1991.
ANSI/IEEE 241, *Recommended Practice for Electric Power Systems in Commercial Buildings* (Gray Book), 1990.
ANSI/IEEE 242, *Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems* (Buff Book), ~~1986 (Reaff. 1991)~~ 2001.
ANSI/IEEE 315 (ANSI Y32.2-75), *Graphic Symbols for Electrical and Electronics Diagrams,* 1975 (Reaff. 1993).
ANSI/IEEE 400, *Guide for Making High-Direct-Voltage Tests on Power Cable Systems in the Field,* 1991.
ANSI/IEEE 432, *Guide for Insulation Maintenance for Rotating Electrical Machinery (5 HP to less than 10,000 HP),* 1992.
ANSI/IEEE 446, *Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications* (Orange Book), 1995.
ANSI/IEEE 450, *Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications,* ~~1995~~ 2010.
ANSI/IEEE 519, *Recommended Practice and Requirements for Harmonic Control in Electrical Power Systems,* 1992.
IEEE 602, *Recommended Practice for Electrical Systems in Health Care Facilities* (White Book), ~~1996~~ 2007.
ANSI/IEEE 739, *Recommended Practice for Energy Management in Industrial and Commercial Facilities* (Bronze Book), 1995.
IEEE C37.41, ~~*Standard Design for High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories,* 1994~~**.** *Standard Design Tests for High-Voltage (>1000 V) Fuses, Fuse and Disconnecting Cutouts, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Fuse Links and Accessories Used with These Devices, 2008*
ANSI/IEEE C37.95, *Guide for Protective Relaying of Utility- Consumer Interconnections*, ~~1989 (Reaff. 1994)~~ 2002.
ANSI/IEEE C37.96, *Guide for AC Motor Protection,* 2000.
IEEE C57.94, *Recommended Practice for Installation, Application, Operation and Maintenance of Dry-Type General Purpose Distribution and Power Transformers,* 1982 (Reaff. 1987).
ANSI/IEEE C57.106, *Guide for Acceptance and Maintenance of Insulating Oil in Equipment,* ~~1991~~ 2006.
IEEE C57.111, *Guide for Acceptance and Maintenance of Silicone Insulating Fluid and Its Maintenance in Transformers,* 1989.
ANSI/IEEE C57.121, *Guide for Acceptance and Maintenance of Less Flammable Hydrocarbon Fluid in Transformers,* 1998.
C.1.3.8 International Electrotechnical Commission (IEC). 3 rue de Varembé, P.O. Box 131, 1211 Geneva 20, Switzerland.
(In the United States, IEC Publications are available from American National Standards Institute, ANSI.)
IEC No. 60417-DB-HS ~~M and supplements,~~ *Graphical Symbols for Use on Equipment,* ~~1994~~ 2008.
C.1.3.9 Intertec Publishing Corp. 9800 Metcalf Avenue, P.O. Box 12901, Overland Park, KS 66282-2901.
EC&M Magazine.
C.1.3.10 McGraw-Hill Publishing Co. 1221 Avenue of the Americas, New York, NY 10020.

D. Beeman, *Industrial Power Systems Handbook*.
E. W. Boozer, *Motor Applications and Maintenance Handbook*.
C. I. Hubert, *Preventative Maintenance of Electrical Equipment*.
C.1.3.11 National Electrical Contractors Association (NECA).
3 Bethesda Metro Center, Suite 1100, Bethesda, MD 20814-5372.
Total Energy Management — A Practical Handbook on Energy Conservation and Management, Index No. 2095.
C.1.3.12 National Electrical Manufacturers Association (NEMA). 1300 North 17th Street, Suite 1847, Rosslyn, VA
22209.
NEMA 280, *Application Guide for Ground-Fault Circuit Interrupters* (see Section 7, Field Test Devices, and Section 8, Field Troubleshooting), 1990.
NEMA AB 3, *Molded Case Circuit Breakers and Their Application* ~~(see Section 7, Maintenance and Field Testing)~~, ~~1996~~ 2006.
NEMA AB 4, *Guidelines for Inspection and Preventive Maintenance of Molded-Case Circuit Breakers Used in Commercial and Industrial Applications*, ~~1996~~ 2009.
NEMA ICS 1.3, *Preventive Maintenance of Industrial Control and Systems Equipment*, 1986 (Reaff. ~~1991~~ 2009).
NEMA ICS 2.3, *Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers Rated Not More Than 600 Volts,* 1995 (Reaff 2008).
NEMA ICS 7, *Industrial Control and Systems Adjustable — Speed Drives,* ~~1993~~ 2006.
ANSI/NEMA MG 2, *Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators* (see Section ~~2.17~~ 8.3, Maintenance), ~~1989 (Reaff. 1999)~~ 2001, (Rev 1-2007).
NEMA PB 1.1, *General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated at 600 Volts or Less,* ~~1996~~ 2007.
NEMAPB 2.1, *General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards Rated 600 Volts or Less,* ~~1996~~ 2007.
C.1.3.13 National Institute for Occupational Safety and Health (NIOSH).
4676 Columbia Parkway, Cincinnati, OH 45226. *Guidelines for Controlling Hazardous Energy During Maintenance and Servicing.*
C.1.3.14 National Safety Council (NSC). ~~444 North Michigan Avenue, Chicago, IL~~ 60611 1121 Spring Lake Drive, Itasca, Ill 60143.
NSC 129.46, *Electrical Inspections Illustrated*.
NSC 635, *Lead-Acid Storage Batteries*.
C.1.3.15 U.S. Department of the Army. U.S. Army Corps of Engineers, 441 G Street NW, Washington, D.C. 20314-1000.
TM-5-682, *Electrical Safety, Facilities Engineering U.S. Army,* November 1999.
TM-5-683, *Electrical Interior, Facilities Engineering U.S. Army,* November 1995.
TM-5-684, *Electrical Exterior, Facilities Engineering U.S. Army,* November 1996.
TM-5-685, *Operation, Maintenance and Repair of Auxiliary Generators U.S. Army,* August 1996.
TM 5-686, *Power Transformer Maintenance and Acceptance Testing,* November 1998.
TM 5-688, *Foreign Voltages and Frequencies Guide,* November 1999.
TM 5-691, *Utility Systems Design Requirements for Command, Control, Communications, Computer, Intelligence, Surveillance, and Reconnaissance (C41SR) Facilities,* December 2000.
TM 5-692-1, *Maintenance of Mechanical and Electrical Equipment at Command, Control Communications, Computer, Intelligence, Surveillance, and Reconnaissance (C41SR) Facilities-Recommended Maintenance Practices,* April 2001.
TM 5-692-2, *Maintenance of Mechanical and Electrical Equipment at Command, Control Communications, Computer, Intelligence, Surveillance, and reconnaissance (C41SR) Facilities-System Design Features,* April 2001.
C.1.3.16 Additional Addresses for Bibliography. Chemical
Rubber Co., 18901 Cranwood Parkway, Cleveland, OH 44128.
E. P. Dutton & Co., 201 Park Avenue S., New York, NY 10003.
Gale Research Co., 1400 Book Tower, Detroit, MI 48226.
Hayden Book Co., Inc., 50 Essex Street, Rochelle Park, NJ 07662.
National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02169-7174.
Plant Engineering, 1350 E. Touhy Avenue, Des Plaines, IL 60018.
Prentice-Hall, Inc., Englewood Cliffs, NJ 07632.
HowardW. Sams Co., Inc., 4300W. 62nd Street, Indianapolis, IN 46268.
TAB Books, Blue Ridge Summit, PA 17214.
Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.
U.S. Government Printing Office, Superintendent of Documents, Mail Stop: SSOP,Washington, DC 20402-9328.
Van Nostrand Reinhold Publishing Company, 135 W. 50th Street, New York, NY 10020
Westinghouse Electric Corp., Printing Division, 1 Stewart Station Drive, Trafford, PA 15085.
John Wiley & Sons, Inc., 605 Third Avenue, New York, NY 10016.
C.2.2 Interruptions. IEEE 1159, Recommended Practice for Monitoring Electric Power Quality, ~~1995~~ 2009.
C.2.3
IEEE 100, Standard Dictionary of Electrical and Electronic Terms, 1996.
ANSI/IEEE 1100, *Recommended Practice for Powering and Grounding* ~~*Sensitive*~~ *Electronic Equipment* (Emerald Book), ~~1992~~ 2005.
C.2.4 Interruptions. IEEE 1159, Recommended Practice for Monitoring Electric Power Quality, ~~1995~~ 2009.
IEEE 1250, ~~Guide for Service to Equipment Sensitive to Momentary Voltage Disturbances, 1995.~~ IEEE Guide for Identifying and Improving Voltage Quality in Power Systems, 2011.
ANSI/NEMA C84.1, Electric Power Systems and Equipment, Voltage Ratings (60 Hertz), ~~1995~~ 2006
Substantiation: Updated referenceso reflect current editions and titles.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.

70B-85 Log #CP13 EEM-AAA **Final Action: Accept**
(Annex D)

Submitter: Technical Committee on Electrical Equipment Maintenance,
Recommendation: The only intended revisions to Annex D are the underlines and the strike-throughs:
D.1.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471. NFPA 70®, National Electrical Code®, ~~2008~~ 2011 edition.
D.1.2.1 ASTM Publications. ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.
ASTM D 92, Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester, 2005a (R 2010).
ASTM D 1933, Standard Specification for Nitrogen Gas as an Electrical Insulation Material, ~~1997~~ 2003 (R 2008).
D.1.2.2 IEEE Publications. Institute of Electrical and Electronics Engineers, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331.
ANSI/IEEE 43, Recommended Practice for Testing Insulation Resistance of Rotating Machinery, 2000.
IEEE 100, Authoritative Dictionary of IEEE Standards Terms, 2000.
ANSI/IEEE 315 (ANSI Y32.2-75), Graphic Symbols for Electrical and Electronics Diagrams, 1975 (Reaff. 1993).
ANSI/IEEE 1100, *Recommended Practice for Powering and Grounding* ~~*Sensitive*~~ *Electronic Equipment* (Emerald Book), ~~1992~~ 2005.
IEEE C57.12.00, General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers, ~~2006~~ 2010.
D.1.2.3 NETA Publications. InterNational Electrical Testing Association, P.O. Box 687, Morrison, CO 80465.
ANSI/NETA, Standard for Maintenance Testing Specifications for Electrical Power Distribution Equipment and Systems, 2011.
Substantiation: Updated references to reflect current editions and titles.
Committee Meeting Action: Accept
Number Eligible to Vote: 15
Ballot Results: Affirmative: 14
Ballot Not Returned: 1 Wyman, B.