Report of the Committee on

Emergency Power Supplies

Douglas S. Erickson, *Chair*
American Society for Healthcare Engineering, VI [U]

Manuel J. DeLerno, *Secretary*
S-P-D Industries Inc., IL [SE]

Ernest E. Allen, Ohio Hospital Insurance Co., OH [I]
Rep. NFPA Health Care Section
James K. Bell, Stewart & Stevenson Services Inc., TX [M]
Rep. Electrical Generating Systems Association
Lawrence A. Bey, Onan Corporation, MN [M]
Robert Burditt, SBC Communications, TX [U]
Ford W. Burgess, Westinghouse Savannah River Co., SC [U]
Dan Chisholm, Motor and Generator Institute, Inc., FL [IM]
Kenneth A. Cotton, Enviroguard, CA [M]
Dennis DeMoss, Sargent & Lundy, IL [SE]
William H. Everard, Everard Fire Protection Engineering Limited, VA [SE]
Gordon S. Johnson, Dundee, FL [U]
Rep. Electrical Generating Systems Association
Ronald Marts, Telcordia Technologies, Inc., NJ [U]
Louis R. Myers, Marathon Electric, WI [M]
Rep. National Electrical Manufacturers Association
David K. Norton, U.S. Department of Veterans Affairs, DC [U]
Daniel J. O'Connor, Schirmer Engineering Corporation, IL [SE]
Rep. American Hotel & Motel Association
Harry Ruetschlin, Underwriters Laboratories Inc., IL [RT]
Timothy G. Stillman, Fort Lauderdale, FL [C]
David Stymiest, Smith Seckman Reid, Inc., LA [SE]
Delmont C. Thurber, Great Falls, MT [SE]
David E. Watters, H. F. Lenz Co., PA [IM]

Alternates

Charles D. Hughes, Westinghouse Savannah River Co., SC [U]
(Alt. to G. S. Johnson)
James R. Iverson, Onan Corporation, MN [M]
(Alt. to L. A. Bey)
Michael S. Shulman, Underwriters Laboratories Inc., CA [RT]
(Alt. to H. Ruetschlin)
Ronald M. Smidt, Carolinas HealthCare System, NC [U]
(Alt. to D. S. Erickson)
Jeffrey L. Steplowski, U.S. Department of Veterans Affairs (183A), DC [U]
(Alt. to D. K. Norton)
Herbert V. Whittall, Electrical Generating Systems Association, FL [M]
(Alt. to J. K. Bell)

Staff Liaison: **Craig H. Kampmier**

Committee Scope: This Committee shall have primary responsibility for documents on performance criteria for the selection and assembly of the components for emergency and standby power systems in buildings and facilities, including categories of power supplies, transfer equipment, controls, supervisory equipment, and all related electrical and mechanical auxiliary or accessory equipment needed to supply emergency or standby power to the utilization equipment. The Committee also shall be responsible for criteria on the maintenance and testing of the system. This Committee does not cover requirements for the application of emergency power systems, self-contained emergency lighting units, and electrical wiring, except that wiring that is an integral part of the system up to the load side of the transfer switch(es).

This list represents the membership at the time the Committee was balloted on the text of this edition. Since that time, changes in the membership may have occurred. A key to classifications is found at the front of this book.

The Report of the Technical Committee on **Emergency Power Supplies** is presented for adoption.

This Report was prepared by the **Technical Committee on Emergency Power Supplies** and proposes for adoption, a complete revision to NFPA 110, **Standard for Emergency and Standby Power Systems**, 1999 edition. NFPA 110-1999 is published in Volume 5 of the 2000 National Fire Codes and in separate pamphlet form.

This Report has been submitted to letter ballot of the **Technical Committee on Emergency Power Supplies**, which consists of 21 voting members. The results of the balloting, after circulation of any negative votes, can be found in the report.

(Log #5)

110- 1 - (1-5 (New)): Accept in Principle
SUBMITTER: Northcentral Regional Fire Code Dev. Committee
RECOMMENDATION: Add a new Section 1-5 to read as follows:
1-5 The installation of wiring, control panels, instrument panels, and other electrical components shall be installed in accordance with NFPA 70.
SUBSTANTIATION: There is not direct reference to NFPA 70 for the wiring, etc. of electrical components for emergency and standby systems. This proposal would place that requirement in the general section for everyone to see.
COMMITTEE ACTION: Accept in Principle.
Revise 5-12.1 to read:
"The distribution and wiring systems with EPSS shall be installed in accordance with ~~applicable standards.~~ NFPA 70, National Electrical Code. ~~(See NFPA 70, National Electrical Code.)~~
Delete A-5-12.1.
COMMITTEE STATEMENT: The committee agrees with the submitter's intent but believes it belongs in the Distribution section.
The appendix note is deleted because it was brought into the body of the document.
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 16
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters

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(Log #CP1)

110- 2 - (Chapter 2): Accept
SUBMITTER: Technical Committee on Emergency Power Supplies
RECOMMENDATION: All of Chapter 2 (save two sentences) is nonmandatory. Either move this material to Chapter 1, which is administrative, or make this an appendix, or rewrite as mandatory.
SUBSTANTIATION: This proposal was generated as a result of an editorial review of this document. The recommendation contains recommended editorial changes that resulted from editing at the pamphlet stage of the last code cycle that require committee review and action.
COMMITTEE ACTION: Accept.
COMMITTEE STATEMENT: See Committee Proposal 110-53 (Log #CP22).
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 16
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters

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(Log #CP2)

110- 3 - (2-2.4.3): Accept
SUBMITTER: Technical Committee on Emergency Power Supplies
RECOMMENDATION: Review text of Paragraph 2-2.4.3 for vague/unenforceable language (i.e., acceptable) and revise.
SUBSTANTIATION: This proposal was generated as a result of an editorial review of this document. The recommendation contains recommended editorial changes that resulted from editing at the pamphlet stage of the last code cycle that require committee review and action.
COMMITTEE ACTION: Accept.
Revise 2-2.4.3(1) to read:
"of a quality ~~essentially equal to commercial power or acceptable for~~ within the operating limits of the load."
2-2.4.3(2) to read:
"within the time specified for the type ~~and~~ as defined in Table 2-2.2."
2-2.4.3(3) to read:
"for a duration specified for the class as defined in Table 2-2.3."
COMMITTEE STATEMENT: See Committee Proposal 110-53 (Log #CP22).
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 16
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters

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(Log #4)

110- 4 - (3-1.1): Accept
SUBMITTER: Northcentral Regional Fire Code Dev. Committee
RECOMMENDATION: Revise text to read as follows:
The following energy sources shall be permitted for use for the emergency power supply (EPS):
a. Liquid petroleum products at atmospheric pressure
b. Liquefied petroleum gas (liquid or vapor withdrawal)
c. Natural or synthetic gas
Exception:* For Level 1 installations in locations where the probability of interruption of off-site fuel supplies is high ~~(e.g., due to earthquake, flood damage, or a demonstrated utility unreliability)~~, on-site storage of an alternate energy source sufficient to allow full output of the emergency power supply system (EPS) to be delivered for the class specified shall be required, with provision for automatic transfer from the primary energy source to the alternate energy source.
Add a new appendix note to read as follows:
A-3.1.1 Exception. Examples of probability of interruption could include: earthquake, flood damage, or a demonstrated utility unreliability.
SUBSTANTIATION: This exception should be placed in the appendix as it is confusing in the existing text. The list is also not inclusive of many other items that could interrupt fuel supplies and should not be included in the standard.
COMMITTEE ACTION: Accept.
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 16
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters

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(Log #CP3)

110- 5 - (3-2.1): Accept
SUBMITTER: Technical Committee on Emergency Power Supplies
RECOMMENDATION: Review text of Paragraph 3-2.1 for vague/unenforceable text (i.e., acceptable) and revise.
SUBSTANTIATION: This proposal was generated as a result of an editorial review of this document. The recommendation contains recommended editorial changes that resulted from editing at the pamphlet stage of the last code cycle that require committee review and action.
COMMITTEE ACTION: Accept.
COMMITTEE STATEMENT: See Committee Action on Proposal 110-6 (Log #6).
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 16
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters

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Since the ballot on this Proposal did not confirm the Committee Action, the Committee is soliciting public comment for review when the proposal is reconsidered by the Committee as a Public Comment.

(Log #6)

110- 6 - (3-2.1):
SUBMITTER: Lawrence A. Bey, Onan Corp.
RECOMMENDATION: Revise text as follows:
The capability of the energy converter, with its controls and accessories, to survive without damage from common and abnormal disturbances in actual load circuits shall be demonstrable by tests on

separate prototype models. ~~or by acceptable tests on the system components as performed by the component suppliers.~~ Where available, the generator set(s) shall be listed for emergency service as a completely factory-assembled and factory-tested apparatus.

SUBSTANTIATION: Underwriters Laboratories Standard 2200 has been published for listing emergency generator sets for stationary installations. The scope of UL 2200 is equipment intended for installation and use in accordance with the National Electrical Code, NFPA 70, NFPA 37, NFPA 99, and NFPA 110.

Listing of generator set equipment can provide a consistent basis for approval of equipment by the authority having jurisdiction based on a published standard for safety. Listing relieves the authority having jurisdiction of the burden of examination of equipment for which the authority having jurisdiction lacks the resources and facilities. Without listing, the possibility exists for inconsistent examination and approval between jurisdictions.

In many local jurisdictions it is mandatory for all installed electrical equipment to be listed. In these jurisdictions the only alternative available for generator sets has been field inspection by a third-party certifier of each unit as installed, and the expense is passed directly to the end user.

UL 2200 includes a standard testing protocol for a complete factory-assembly. Testing per UL 2200 demonstrates compliance with NFPA 110, 3-2.1. Individual component testing by individual component suppliers does not demonstrate the required compatibility and performance as it relates to safety.

COMMITTEE ACTION: Accept.

NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21

VOTE ON COMMITTEE ACTION:

AFFIRMATIVE: 5

NEGATIVE: 11

NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters

EXPLANATION OF NEGATIVE:

ALLEN: I disagree with the committee action. UL Certification of emergency generators is not necessary. From my experience of over 20 years with an insurance company insuring several hundred hospitals across the country, we have not paid any claims for patient injury from failure of the emergency generator.

There have been very few emergency generator failures, and these were due to lack of required maintenance or human error (failure to reset a switch), and UL 2200 would not have any impact in this area. Reliance on UL certification may give a false sense of security, as some hospital engineers might think the UL certified units would require less maintenance.

Hospitals also have very tight budgets, and the extra cost of UL 2200 could take away needed money from more important patient care areas. Patient safety is a priority, and the money that would be spent on UL certification does not provide a good return due to the very low exposure. There is no need for UL 2200, as evidenced by lack of evidence of patient injury.

NFPA 110, which includes language to follow the manufacturer's guidelines, provides the necessary information to install and maintain the emergency generator in good working condition. Requiring UL certification would only add to the cost of the already strained budget of healthcare facilities.

BURDITT: The requirement for "listing" the unit as "a completely factory-assembled and factory-tested apparatus" is an expensive extravagance and is unnecessary in achieving a safe and reliable unit. In the telecommunications industry, we use a variety of generator packages to support our equipment. Many are diesel engine-generator sets that are assembled and packaged by a single manufacturer. Some, however, are packages that are assembled by our installation vendors to meet site-specific requirements. The tests and requirements we put on our gensets and installation vendors meet, and in some cases exceed, that of UL and other "listing" agencies because of the value we place on the reliability of our network.

CHISHOLM: The requirement for listing generator sets in accordance with the current draft of UL 2200, or any the existing "listing standard" will NOT:

1. Increase the reliability of the EPS, or
2. Reduce safety hazards for the operator.

It WILL:

1. Increase the cost of generators with no offsetting benefit, and
2. Increase the chances of acceptance of substandard equipment by authorities having jurisdiction.

UL first promoted UL 2200 as a standard that would "...evaluate generators for their abilities to operate safely and reliably during power interruptions..." But from the start, UL has relied on scare tactics as a way to propagandize this standard—as demonstrated in their article entitled "Can You Start Me Up?", which appeared in Vol. 7, No. 1, of UL's The Code Authority. The article begins with the following ludicrous description: "Mercy Hospital, Anytown, U.S.A., 10:37 p.m. A heavy thunderstorm shakes, rattles and rolls the entire town. Downstairs in the hospital basement, several three-year-old emergency power generators are poised for action. But they've never been used in real-life situations. Not ever. Sure, they've been checked (one or twice) and maintained (cleaned off a few times) — but, for the most part, they've sat silently, just in case. In seven minutes, power throughout Anytown will go out. Will the hospital generators kick in, or will they go out too?" For UL to describe health care facility EPS's in a way that suggests most if not all EPS's are poorly maintained and unlikely to work as prescribed in a power outage confirms UL has not even bothered reading NFPA 110, Chapter 6, especially 6-4 which is referred to by the Joint Commission on Accreditation of Healthcare Organizations, which has "deemed status" from the Health Care Financing Administration. It is this standard which assures an EPS is tested and maintained according to the manufacturer's recommendations — unquestionably the proven method for guaranteeing generator set reliability.

UL 2200, on the other hand, cannot guarantee reliability or reduce safety hazards. UL has touted 2200 as a standard that would do just that: increase reliability and reduce chances of injury, death and property damage; yet when questioned regarding details of incidents where compliance to UL 2200 could have had an effect related to these issues, UL did not have an answer. This is because there have been no such occurrences, and with no empirical data proving a need for UL 2200, it is untenable that the public be burdened with another expensive standard.

Far from reducing safety hazards, UL 2200 has not addressed even the simplest and most visible Federal standard...1910.17, Lockout/Tagout. Paragraph 1910.147(c)(2)(iii) states in part "...whenever new machines or equipment are installed, energy isolating devices for such machine or equipment shall be designed to accept a lockout device." If UL 2200 is supposed to be in part a safety standard why has UL ignored a "code" that has saved more lives than any other OSHA requirement?

UL would like us to believe that if a generator has the UL 2200 listing, it is set for life. In the substantiation section of Proposal 110-6, the submitter makes the statement that listing would, "...relieve(s) the authority having jurisdiction of the burden of examination of equipment for which the authority having jurisdiction lacks the resources and facilities." UL 2200, which was written without due regard for NFPA 70, NFPA 110 or the simplest of Federal standards, is simply not a viable substitute for an AHJ visiting the job site and inspecting the set according to a professional engineer's specifications and NFPA standards. This is a dangerous proposition.

UL 2200 is expensive. For those who will be paying the increased "tax" imposed by UL it's not a laughing matter. UL has only one goal in mind...money. Unfortunately, UL has convinced one generator manufacturer that listing their sets will give them a marketing advantage, essentially increasing their market share—at the expense of the American taxpayer.

Additional information on UL 2200 and the opinion of other NFPA Technical Committee members, including Doug Erickson, Chairman, NFPA 110; and Hugh Nash, PE, Chairman of the Electrical Section of NFPA 99, can be found at http://www.mgi-hcn.com/archive/topic/ul.htm.

DeLERNO: Either the assembly is important enough to be listed or it isn't. The "where available" permits the manufacturer to decide based upon commercial considerations. I consider this unacceptable.

DeMOSS: I have done a further review of the proposed change to 3-2.1 as described in the package I received dated 11/7/2000. I am changing my vote to negative on Log #6 for the following reason:

The listing of all emergency diesel sets through NFPA testing would be of limited value. I believe the existing wording is more than adequate to assure a safely designed and constructed DG set is provided. There would be a number of problems as sub components are upgraded over time and the need to retest would place an undue burden on the industry with little or no value. Finally, I don't believe there has been a problem with the overall design and construction of DG sets with use of the existing NFPA 110 standard. I find the existing code, NFPA 110 language adequate for DG set qualification and testing.

ERICKSON: In my opinion as the representative of a major industry for which this standard will have the greatest impact, UL has been obstinate in their dealing with the generator industry and had blinders on when others, who typically support their standards, came forward and indicated that UL 2200 was not a necessary standard.

Here is a list of concerns, many of which have been discussed and documented before in various forums.

- Since this listing is for a field-assembled system (including engines, generators, cooling systems, batteries, battery chargers, and other accessories), there could be a requirement for licensing dealers to field-verify the assembly, or UL could actually travel to the site to inspect the work. At any rate, the effect will be to increase the cost of standby generators, while providing no reliability benefit. In fact, the new UL listing could actually have the reverse effect on reliability by giving the user a false sense of security.
- Lack of maintenance has emerged time and time again as the biggest culprit in engine failure. Not only will UL 2200 not eliminate this problem, it will tend to contribute to it, by creating a false sense of confidence about a particular generator's reliability, and encouraging a lax attitude towards its maintenance and testing.
- UL can't site even five cases in which people or properties were damaged that its new standard could have prevented? The only party that will benefit from UL 2200 is UL itself.
- Health care facility generators are already regulated quite adequately; the great majority of us in the health care industry know this - and we also know if such a plague of substandard generators existed such as UL would have us believe, the insurance companies, AHJ's and the Federal Government would have been up in arms long ago demanding higher levels of regulation from the NFPA — or even UL.
- NFPA 110 is a comprehensive, prescription and performance-based standard whose specifications cover every detail of what a generator needs to be able to do, then specifies installation requirements and maintenance that follows the manufacturer's recommendations. When design engineers working on a generator conform to NFPA 110, that generator will contain all of the ingredients needed for that machine to do its job well. Then, before it is ever formally in place within a facility, it must undergo acceptance testing that is specifically designed to push the machine to its limits. Generators designed and tested with this adherence to the existing standard have proven time after time to be adequate and reliable. Why try to fix something that isn't broken?

JOHNSON: The clause that the panel has voted to delete, "or by acceptable tests on the system components as performed by the component suppliers," was the result of a compromise in the industry at the 1984 NFPA Fall Meeting, without which NFPA 110 would not have been accepted. The controversy about "prototype testing" arose over strong opposition from a segment of the industry who assemble generator sets to meet specifications. Many generator sets are one of a kind built to meet the requirements of a particular specification. That type of application does not lend itself to listing. If listing were required there is no laboratory in the country with the expertise to make the tests. I have been through this process and we had to teach the testing agency, at our expense, how to run the tests. The additional cost to the end user will be very sizable with the only gain being that it makes the job of the authority having jurisdiction easier.

NFPA 110 is intended to ensure the performance required for emergency loads. It has been carefully revised to eliminate weaknesses. It is concise and to the point. In use for fifteen years, it has proved its effectiveness. It serves its purpose. A construction standard is not necessary. Generator sets meeting it will serve the performance requirements of emergency power.

UL 2200 the standard proposed to virtually supplant NFPA 110 is a cumbersome construction document, consisting of 150 pages (cost about $150). It is five times as long as NFPA 110 and made up mostly of unnecessary mechanical construction requirements transferred from other UL standards. It was based upon a UL UPS standard, which has no engine or generator. Unlike NFPA standards it is not a consensus standard. There was one meeting of a nonvoting industry advisory committee before its adoption. The committee was not even advised of its release or given a copy. Frequent reassignment of personnel at UL have thwarted industry attempts to assist them to gain experience in the performance required of generator sets.

Summary: The proposal goes against the original intent of NFPA 110 by removal of a fundamental clause. Listing will not improve performance or reliability of generator sets. It will seriously inflate costs. It will virtually eliminate a large segment of the generator set industry. It is impractical to submit every unit for listing. Therefore, I vote against the proposal.

MYERS: At this time UL 2200 has not been finalized into a clear, well defined, and usable document. This leaves it open to interpretation.

Thus far UL 2200 is incomplete, contains unproven exceptions, and unclear statements. This standard needs to be revised before it will be a usable standard.

Here are some of the items that are in question:

1. UL gave an exception, in Table 38.2, item d., page 99, that states that if the current density in a bus bar is less than the limits given in Section 18.2.9, that it will not require temperature testing because it will automatically comply with the temperature limits in Table 38.2, page 97. This statement has not been proven by UL.
2. UL also gave an exception for dual frequency rated units. In section 37.3, the exception states that when a unit is marked with a dual frequency or a range of frequencies, the temperature testing, as specified in Section 38, is to be conducted at the lowest frequency. For a unit that is 50/60 Hz rated, the unit then can be tested at 50 Hz, and pass, and, by interpretation, be acceptable at 60 Hz. For the 60 Hz rating, more current will be passing through the connections, and an increase in "skin effect", will cause bus bars, connections, etc., to rise in temperature. This statement needs to be clarified as to the intent.
3. UL does not, anywhere in UL 2200, give a clear, concise definition of a bus bar. Without this definition, clear understanding of what has to be tested in Section 38 is not possible. UL will need to add this to the specification.

These are just a few of the items that need to be addressed in the next revision of UL 2200.

In addition to the incompleteness of UL 2200, it can also place undue burden upon the genset manufacture, and final end user, where none had existed before.

Also, the requirement of a genset to be UL 2200 listed could create a market advantage for some manufacturers. This requirement could prohibit the end user from using the most cost/performance effective genset.

Finally, UL 2200 does little if anything to enhance the requirements set forth in NFPA 110.

STYMIEST: I have followed both sides of the debate regarding UL 2200 with much interest because of my experience both as the facilities electrical engineer for a healthcare system and also as a consulting electrical engineer to many different industries. I am voting negatively on Proposal 110-6 for the reasons enumerated below:

I believe that the net effect of UL 2200 will be to increase the cost of standby generator sets, while providing little or no reliability benefit.

NFPA 110 already includes comprehensive requirements for generator set performance, operation, and maintenance. I do not believe that NFPA 110 should also require UL listing as stated in Proposal 110-6.

Experienced generator set users, owners, maintenance companies and consultants know that lack of maintenance is the biggest culprit in engine failure. UL 2200 will not eliminate this problem. Rather, UL 2200 may contribute to it, by creating among unsophisticated users and owners a false sense of security about a particular generator set's intrinsic reliability, and thereby encouraging a lax attitude towards its maintenance and testing.

Health care facility generator sets are already regulated quite adequately, and the great majority of us in the health care industry know this.

THURBER: Not clarified to my knowledge.

WHITTALL: I would like to change the vote I previously submitted and cast a vote against NFPA 110-6 (Log #6), for the following reason:

As written, the sentence "Where available, the generator set(s) shall be listed for emergency service as a complete factory-assembled and factory-tested apparatus." Puts an enormous cost burden on all facilities covered by NFPA 110 without any advantage to that facility except the inspector does not need to be as skilled. However, a less skilled inspector is more of a hazard since the really dangerous items are the electrical and fuel connections to the generator set and not the generator set itself.

COMMENT ON AFFIRMATIVE:

BEY: The membership of NFPA should support acceptance of Proposal 110-6. Third-party testing and listing of generator sets by a NRTL benefits fire and life safety of the public. There may be negative comments on this proposal saying that listing will increase the cost to end users without any improvement in reliability. Those comments will miss the point that listing is about safety, and that product testing and listing is widely accepted throughout the electrical industry as minimum requirements. By the time the 2002 edition of NFPA 110 is adopted generator set manufacturers will have had more than four years to obtain listing since publication of UL Standard 2200 in September of 1998.

(Log #7)

110- 7 - (3-3.1): Accept in Principle

SUBMITTER: Lawrence A. Bey, Onan Corp.

RECOMMENDATION: Revise text as follows:

"The EPS shall be heated as necessary to maintain the water jacket temperature determined by the EPS manufacturer to be sufficient for cold start and load acceptance for the type of EPSS. Provision shall be made to maintain the EPS ~~energy converter~~ room and outdoor housings containing Level 1 ~~rotating~~ equipment as specified in 5-7.6. ~~Where an engine water jacket heater is required, it shall maintain the jacket water temperature at not less than 90°F (32°C). Units housed outdoors shall have an automatically controlled heater to keep the jacket water temperature at not less than 90°F (32°C). Provision shall be made for units housed outdoors to maintain the energy converter enclosure at not less that 32°F (0°C), or battery heaters shall be provided to maintain battery temperature at a minimum of 50°F (10°C) and shall automatically shut off when the battery temperature reaches 90°F (32°C).~~ All prime mover heaters shall be automatically deactivated while the prime mover is running. ~~(For combustion turbines, see 5-7.6.)~~"

SUBSTANTIATION: 1. There is considerable editorial confusion between 3-3.1 and 5-7.6 and 5-7.7. This proposal attempts to clarify that confusion by separating the temperature of the EPS water jacket in 3-3.1, and the minimum temperature of the ambient in 5-7.6.

2. The problem with a prescriptive requirement for a specific temperature (90°F) is that compliance with the standard can be claimed, without meeting the desired performance (cold start and load acceptance) that makes coolant heaters necessary. Putting the requirement in performance terms places the responsibility for correct sizing of the coolant heaters on the EPS manufacturer where it belongs. The actual temperature required for the desired performance may be lower or higher than 90°F and will vary considerably between specific make and models of engine.

3. Battery heaters are unreliable. One failure mode is loss of regulation (stuck thermostat) where the heater is ON continuously which results in failed batteries.

COMMITTEE ACTION: Accept in Principle.

Delete ~~to be sufficient~~ in the first sentence. Text of the first sentence will now read as follows:

"The EPS shall be heated as necessary to maintain the water jacket temperature determined by the EPS manufacturer for cold start and load acceptance for the type of EPSS."

COMMITTEE STATEMENT: To conform to the NFPA Manual of Style.

NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21

VOTE ON COMMITTEE ACTION:

AFFIRMATIVE: 15

NEGATIVE: 1

NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters

EXPLANATION OF NEGATIVE:

JOHNSON: I am not convinced that a temperature of 90°F (32°C) is too high for any application. The current requirement gives the operator a check point. I do not disagree with a higher temperature if recommended by the manufacturer, but I do not think the 90°F should be lowered. The claim that battery heaters are unreliable needs more substantiation.

(Log #CP4)

110- 8 - (3-4.1): Accept

SUBMITTER: Technical Committee on Emergency Power Supplies

RECOMMENDATION: Review text of Paragraph 3-4.1 for vague/unenforceable text (i.e., sufficient) and revise.

SUBSTANTIATION: This proposal was generated as a result of an editorial review of this document. The recommendation contains recommended editorial changes that resulted from editing at the pamphlet stage of the last code cycle that require committee review and action.

COMMITTEE ACTION: Accept.

COMMITTEE STATEMENT: See Committee Proposal 110-53 (Log #CP22).

NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21

VOTE ON COMMITTEE ACTION:

AFFIRMATIVE: 16

NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters

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(Log #8)

110- 9 - (3-5.3.2): Accept

SUBMITTER: Lawrence A. Bey, Onan Corp.

RECOMMENDATION: Revise text as follows:

"Solenoid valves, where used, both in the fuel line from the supply or day tank~~s~~ closest to the generator set and in the water cooling lines, shall operate from battery voltage."

SUBSTANTIATION: Solenoid valves between the engine fuel pump and the closest fuel supply tank, whether that tank is a day tank or supply tank, have to use battery voltage to be sure the engine will start and run. The generator set manufacturer supplies that solenoid valve and it is picked up with the run signal using battery voltage. There should be no other solenoid valves between the engine and the closest fuel tank. Solenoid valves on the other side of the closest tank should be permitted to operate at battery voltage or use AC voltage from the generator set output. There are several other devices that require AC from the generator output for the generator set to run including fuel pumps, either at the day tank or main supply tank, so there is no reason not to allow solenoid valves to operate with AC.

The problem is that some facilities, typically larger hospitals, use a main fuel supply tank with a manifold that feeds both the boiler(s) and the generator set. A pump as required for the boiler feed pressurizes the manifold. A pressurized line would also be the case in facilities using an overhead supply tank and gravity feed to the day tank. The day tank float controls a solenoid valve just ahead of the day tank. Where the day tank control operates at 110v it would be necessary to add relay to operate the solenoid valve at battery voltage in order to comply with the present requirement.
COMMITTEE ACTION: Accept.
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 16
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters

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(Log #9)

110- 10 - (Table 3-5.5.2(d)): Accept
SUBMITTER: Lawrence A. Bey, Onan Corp.
RECOMMENDATION: Revise item (b) and add a new note as follows:
(b) Low water temp.
~~<70°F (21°C)~~
Note 7. Item (b) shall be set at 20°F (11°C) below the regulated temperature determined by the EPS manufacturer as required by 3-3.1.
SUBSTANTIATION: The purpose of the low coolant temperature alarm is to signal that the water jacket heaters have stopped working. The setpoint for the alarm should be below the temperature determined by the EPS manufacturer as sufficient for cold start and load acceptance.
COMMITTEE ACTION: Accept.
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 15
NEGATIVE: 1
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters
EXPLANATION OF NEGATIVE:
JOHNSON: In accord with negative vote on Proposal 110-7 (Log #7).

(Log #21)

110- 11 - (Table 3-5.5.2(d)): Accept in Principle
SUBMITTER: Dan Chisholm, Healthcare Circuit News
RECOMMENDATION: Insert a "required," "indicator function" for "battery load test failure" under C.V. and R.A.
SUBSTANTIATION: A mandatory battery load test sensor within the EPS controls will add integrity to the EPS by alerting testing and maintenance personnel of impending failure of the EPS to start.
COMMITTEE ACTION: Accept in Principle.
Insert as new (l), Low Cranking Voltage.
Under Level 1 CV & RA, denote required, X
Under Level 2 CV & RA, denote option, O. See Table as shown on the next page:
COMMITTEE STATEMENT: Clarification of submitter's intent.
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 15
NEGATIVE: 1
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters
EXPLANATION OF NEGATIVE:
BURDITT: Not all start batteries are valve regulated-lead acid type that can be measured with a "mandatory battery load test sensor" readily available on the market. Flooded Ni-Cd batteries don't have an established failure mode and don't currently have an accurate "load test" identified for predicting reliability. Some load test sensors also unnecessarily wear down cells by constantly applying mini-cycles to them.

(Log #20)

110- 12 - (3-5.5.2(g) (New)): Reject
SUBMITTER: Dan Chisholm, Healthcare Circuit News
RECOMMENDATION: Insert: "A low battery load test alarm indicating a voltage drop of more than 20 percent of nominal voltage during starting."
SUBSTANTIATION: To coordinate with proposal to amend Table 3-5.5.2(d).
COMMITTEE ACTION: Reject.
COMMITTEE STATEMENT: Adequately covered in paragraph 3-5.5.2(d).
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 16
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters

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(Log #11)

110- 13 - (4-2.4): Reject
SUBMITTER: Lawrence A. Bey, Onan Corp.
RECOMMENDATION: Add: 4-2.4 Level 1 transfer equipment shall supply only Level 1 loads. Level 2 transfer equipment shall supply only Level 2 loads.
Renumber existing 4-2.4 as 4-2.5 and 4-2.5 as 4-2.6.
SUBSTANTIATION: A requirement that optional loads are not to be permitted on Level 1 transfer equipment should be added to be consistent with NEC, 700-6(d). Further, to be complete it should also be stated that Level 2 switches are not allowed to supply Level 1 loads.
COMMITTEE ACTION: Reject.
COMMITTEE STATEMENT: Outside scope of the document.
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 16
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters

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(Log #10)

110- 14 - (4-2.4.1.1 (New)): Accept
SUBMITTER: Lawrence A. Bey, Onan Corp.
RECOMMENDATION: Add a new 4-2.4.1.1 as follows:
"An automatic transfer switch shall visually annunciate when "not-in-automatic"."
SUBSTANTIATION: Automatic transfer switches are provided with a means to disable the automatic operation of the switch for service purposes. If disabled, it should be indicated visually similar to the "not-in-auto" requirement for the generator set control.
COMMITTEE ACTION: Accept.
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 16
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters
COMMENT ON AFFIRMATIVE:
BURDITT: Should read: "An automatic transfer switch shall annunciate, either visually or audibly, when "not in automatic" condition exists."

Table 3-6.5.2(d) Safety Indications and Shutdowns

		Level 1			Level 2		
	Indicator Function (at Battery Voltage)	**C.V.**	**S**	**R.A.**	**C.V.**	**S**	**R.A.**
(a)	Overcrank	X	X	X	X	X	O
(b)	Low water temp. <70°F (21°C)	X		X	X		O
(c)	High engine temperature prealarm	X		X	O		
(d)	High engine temperature	X	X	X	X	X	O
(e)	Low lube oil pressure prealarm	X		X	O		
(f)	Low lube oil pressure	X	X	X	X	X	O
(g)	Overspeed	X	X	X	X	X	O
(h)	Low coolant level	X	O	X	X	O	X
(i)	EPS supplying load	X			O		
(j)	Control switch not in auto. position	X		X	O		
(k)	High battery voltage	X			O		
(l)	Low Cranking Voltage	X		X	O		O
(m)	Low voltage in battery	X			O		
(n)	Battery charger ac failure	X			O		
(o)	Lamp test	X			X		
(p)	Contacts for local and remote common alarm	X		X	X		X
(q)	Audible alarm silencing switch			X			O
(r)	Low starting air pressure	X			O		
(s)	Low starting hydraulic pressure	X			O		
(t)	Air shutdown damper when used	X	X	X	X	X	O
(u)	Remote emergency stop		X			X	

C.V.: Control panel-mounted visual Indication
R.A.: Remote audible
S: Shutdown of EPS
X: Required
O: Optional

Additional Requirements to Table 3-5.2.2(d):
1. Item (o) shall be provided, but a separate remote audible signal shall not be required when the regular work site in 3-5.6.1 is staffed 24 hours a day.
2. Item (b) is not applicable for combustion turbines.
3. Item (q) or (r) applies only where applicable as a starting method.
4. Item (i): EPS ac ammeter shall be permitted for this function.
5. All required C.V. functions shall be annunciated by a remote, common visual indicator. All required functions indicated in the R.A. column also shall be annunciated by a remote, common audible alarm *[see 3-5.5.2(d)]*.
6. Item (h) on gaseous systems shall require a low gas pressure alarm.

(Log #CP5)

110- 15 - (4-2.4.2(b)): Accept
SUBMITTER: Technical Committee on Emergency Power Supplies
RECOMMENDATION: Review text of Paragraph 4-2.4.2(b) for vague/unenforceable text (i.e., adequate) and revise.
SUBSTANTIATION: This proposal was generated as a result of an editorial review of this document. The recommendation contains recommended editorial changes that resulted from editing at the pamphlet stage of the last code cycle that require committee review and action.
COMMITTEE ACTION: Accept.
COMMITTEE STATEMENT: See Committee Proposal 110-53 (Log #CP22).
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 16
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters

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(Log #CP6)

110- 16 - (4-3.2): Accept
SUBMITTER: Technical Committee on Emergency Power Supplies
RECOMMENDATION: Review text of Paragraph 4-3.2 for vague/unenforceable text (i.e., adequate) and revise.
SUBSTANTIATION: This proposal was generated as a result of an editorial review of this document. The recommendation contains recommended editorial changes that resulted from editing at the pamphlet stage of the last code cycle that require committee review and action.
COMMITTEE ACTION: Accept.
COMMITTEE STATEMENT: See Committee Proposal 110-53 (Log #CP22).
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 16
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters

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(Log #27)

110- 17 - (4-5.1): Reject
SUBMITTER: Todd Lottmann, Washington, MO
RECOMMENDATION: Modify 4-5.1 to read as follows:
4-5.1 General. The overcurrent protective devices in the EPSS shall be selectively coordinated, ~~to optimize selective tripping of the circuit overcurrent protective devices when a short circuit occurs~~ localizing a fault condition to restrict outages to only the effected equipment under all fault conditions. The maximum available short-circuit current from both the utility source and the emergency energy source shall be evaluated to satisfy this coordination ability.

SUBSTANTIATION: The current standard lacks a definition of coordination. Therefore, a description of coordination needs to be added to the text to clarify its meaning. In addition, as is currently written, the coordination of the emergency system only needs to be "optimized." There is no mandate for selective coordination. If a fault occurs on an emergency system the overcurrent protective device nearest the fault must be the only one that opens, thus leaving power to the rest of the electrical system. Both fuses and circuit breakers can be used to meet this proposed change. Circuit breakers have adjustable instantaneous trip settings, short time delay, and zone selective interlocking to help them coordinate. Fuses can be coordinated using published ratio charts. Losing power to part or all of an emergency system due to a fault in only one branch circuit is a hazardous situation that must be avoided by mandating total selective coordination.
COMMITTEE ACTION: Reject.
COMMITTEE STATEMENT: The committee believes current language adequately addresses the issue of coordination.
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 16
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters

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(Log #CP7)

110- 18 - (5-1.3): Accept
SUBMITTER: Technical Committee on Emergency Power Supplies
RECOMMENDATION: Review text of Paragraph 5-1.3 for vague/unenforceable text (i.e., consideration) and revise.
SUBSTANTIATION: This proposal was generated as a result of an editorial review of this document. The recommendation contains recommended editorial changes that resulted from editing at the pamphlet stage of the last code cycle that require committee review and action.
COMMITTEE ACTION: Accept.
COMMITTEE STATEMENT: See Committee Proposal 110-53 (Log #CP22).
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 16
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters

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(Log #13)

110- 19 - (5-1.6): Accept
SUBMITTER: Lawrence A. Bey, Onan Corp.
RECOMMENDATION: Delete existing 5-1.6 and replace with: When the normal power source is not available, the EPS shall be permitted to serve optional loads other than Level 1 and Level 2 system loads, provided that the EPS has adequate capacity, or automatic selective load pickup and load shedding is provided as needed to ensure adequate power to (1) the Level 1 loads, (2) the Level 2 loads, and (3) the optional loads, in that order of priority. When normal power is available, the EPS shall be permitted to be used for other purposes such as peak load shaving, internal voltage control, load relief for the utility providing normal power, or cogeneration.
SUBSTANTIATION: The present requirements do not allow use of a single generator set for loads other than Level 1 or 2 loads when the normal power source fails even if the EPS has the capacity to do so. The proposal allows an EPS to supply other loads if provided with adequate capacity or selective load pickup and load shed functions. With normal power available, permission is given for the EPS to be used for other purposes consistent with NFPA 99.
COMMITTEE ACTION: Accept.
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 16
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters

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(Log #CP8)

110- 20 - (5-2.4): Accept
SUBMITTER: Technical Committee on Emergency Power Supplies
RECOMMENDATION: Review text of Paragraph 5-2.4 for vague/unenforceable text (i.e., consideration) and revise.
SUBSTANTIATION: This proposal was generated as a result of an editorial review of this document. The recommendation contains recommended editorial changes that resulted from editing at the pamphlet stage of the last code cycle that require committee review and action.
COMMITTEE ACTION: Accept.
COMMITTEE STATEMENT: See Committee Proposal 110-53 (Log #CP22), 110-34 (Log #CP14), and 110-22 (Log #CP23).
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 16
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters

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(Log #14)

110- 21 - (5-2.5): Accept
SUBMITTER: Lawrence A. Bey, Onan Corp.
RECOMMENDATION: Revise text as follows:
The EPS equipment shall be installed in a location that will permit ready accessibility and adequate [minimum of 30 in. (76 cm)] working space ~~around the unit~~ in the direction of access for inspection, repair, maintenance, cleaning, or replacement.
SUBSTANTIATION: A typical installation has the radiator end on the generator set placed as close as possible to an exterior wall and ducted outdoors so that there is not working space on all sides around the unit.
COMMITTEE ACTION: Accept.
COMMITTEE STATEMENT: See Committee Proposal 110-22 (Log #CP23).
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 15
NEGATIVE: 1
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters
EXPLANATION OF NEGATIVE:
DeLERNO: I cannot rationalize the "accept" action of two differing texts. Leave 5-2.5 as at present.

(Log #CP23)

110- 22 - (5-2.5): Accept
SUBMITTER: Technical Committee on Emergency Power Supplies
RECOMMENDATION: Replace "adequate [a minimum of 30 in. (76 cm)] working space" with "a minimum of 36 in. (76 cm) of clearance from the prime mover valve covers." Text will now read as follows:
"The EPS equipmetn shall be installed in a location that permits ready accessibility and ~~adequate [a minimum of 30 in. (76 cm)]~~ a minimum of 36 in. (76 cm) clearance from the prime mover valve covers in the direction of access for:"
SUBSTANTIATION: Clarifies the committee's intent of providing access and where the access shall be provided. See Comittee Proposal 110-34 (Log #CP14) and 110-53 (Log #CP22).
COMMITTEE ACTION: Accept.
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 15
NEGATIVE: 1
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters
EXPLANATION OF NEGATIVE:
DeLERNO: I cannot rationalize the "accept" action of two differing texts. Leave 5-2.5 as at present.

(Log #15)

110- 23 - (5-3): Accept

SUBMITTER: Lawrence A. Bey, Onan Corp.

RECOMMENDATION: Move the exception from 5-3.2 to 5-3.1 and revise as follows:

Exception: This requirement shall not apply to units located ~~housed~~ outdoors in enclosures that do not include walk-in access.

SUBSTANTIATION: There have been cases where a generator set in an outdoor "skintight" enclosure was required to be provided with battery lighting because the exception is in the wrong place and no distinction is made between "skintight" and "walk-in" enclosures.

COMMITTEE ACTION: Accept.

Delete "Exception" per Committee Proposal 110-53 (Log #CP22). Insert as a paragraph under 5-3.1.

COMMITTEE STATEMENT: See Committee Proposal 110-53 (Log #CP22).

NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21

VOTE ON COMMITTEE ACTION:

AFFIRMATIVE: 16

NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters

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(Log #2)

110- 24 - (5-7 and A-5-7): Accept in Principle

SUBMITTER: Lawrence A. Bey, Onan Corp.

RECOMMENDATION: Revise as follows:

5-7.1 With the EPS running at rated load, sufficient ventilation air flow shall be provided to limit the maximum air temperature in the EPS room to the maximum ambient air temperature required by the specific EPS manufacturer not to exceed 30°F (17°C) temperature rise in the room.

5-7.1.1 Consideration shall be given to ~~properly sizing the ventilation or air conditioning systems to remove~~ all the heat rejected to the EPS equipment room by the energy converter, uninsulated or insulated exhaust pipes, and other heat producing equipment.

~~5-7.2 Adequate ventilation shall be provided to prevent temperatures or temperature rises in the EPS and related accessory equipment in excess of the recommendations of the manufacturer.~~

~~5-7.3 For the EPS equipment room, the ventilation or cooling equipment, or both, shall be sized so that the ambient temperature shall not exceed the EPS equipment manufacturer's criteria or allowable maximum temperatures.~~

5-7.4~~2~~ Adequate ~~combustion~~ air flow shall be supplied to the EPS equipment for combustion.

5-7.3 Ventilation air supply shall be from out-of-doors.

5-7.4 Ventilation air flow shall be provided to supply and discharge cooling air as necessary for radiator cooling of the EPS to run at rated load, when required.

5-7.4.1* Ventilation air supply and discharge for radiator cooled EPS shall have a maximum static restriction of 0.5 inches of water column (125 Pa) in the discharge duct at the radiator outlet.

5-7.4.2 Radiator air discharge shall be ducted out-of-doors.

5-7.5 Motor operated dampers, when used, shall be spring operated to open and motor closed.

Renumber 5-7.6 thru 5-7.8 as 5-7.5 to 5-7.7.

A-5.7.1 During operation, EPS and related equipment reject considerable heat that needs to be removed by proper ventilation or air-cooling. In some cases, outdoor installations rely on natural air circulation, but enclosed installations need properly sized, properly positioned ventilation facilities to prevent recirculation of cooling air. The optimum position of air supply louvers and radiator air discharge are on opposite walls, both to the outdoors.

A-5-7.5 Consideration should ~~shall~~ be given to designing and sizing an air intake louver system, either gravity or motor operated, so that the proper pressure control and airflow are provided. Dampers and louver restrictions should be considered in sizing the room ventilation requirements.

SUBSTANTIATION: As a result of an inquiry to the NFPA regarding the use of a fire damper in the inlet air duct to the EPS room, a Task Group was appointed to draft a proposal to clarify the EPS room ventilation requirements. The Task Group members were Lawrence Bey, Gordon Johnson, David Norton, and Dan Chisholm. This proposal is the result of the Task Group activity.

Existing 5-7.2 and 5-7.3 address the same issue and are rewritten as new 5-7.1. A maximum air inlet temperature rise of 30°F is given for use in the absence of a specific requirement from the engine manufacturer.

Existing 5-7.1 is renumbered as 5-7.1.1. Reference to sizing is deleted since the performance requirement is clearly stated in new 5-7.1. References to air conditioning systems are removed, as this is believed to be a holdover from stored energy systems which are now in NFPA 111.

Added 5-7.3 to address the issue raised by the inquiry.

Added 5-7.4 and subparts to address the maximum external static restriction for radiator cooled engine generators.

COMMITTEE ACTION: Accept in Principle.

Text will now read as follows:

5-7.1 With the EPS running at rated load, ventilation air flow shall be provided to limit the maximum air temperature in the EPS room to the maximum ambient air temperature required by the EPS manufacturer.

5-7.1.1 Consideration shall be given to all the heat rejected to the EPS equipment room by the energy converter, uninsulated or insulated exhaust pipes, and other heat producing equipment.

5-7.2 Air shall be supplied to the EPS equipment for combustion.

5-7.3 Ventilation air supply shall be from outdoors or from a source outside of the building by an exterior wall opening or from a source outside the building by a 2-hour fire rated air transfer system.

5-7.4 Ventilation air shall be provided to supply and discharge cooling air for radiator cooling of the EPS to run at rated load.

5-7.4.1* Ventilation air supply and discharge for radiator cooled EPS shall have a maximum static restriction of 0.5 inches of water column (125 Pa) in the discharge duct at the radiator outlet.

5-7.4.2 Radiator air discharge shall be ducted outdoors or to an exterior opening by a 2-hour rated air transfer switch.

5-7.5 Motor operated dampers, when used, shall be spring operated to open and motor closed. Fire dampers, shutters, or othe self closing devices shall not be permitted in ventilation openings or ductwork for supply ro return/discharge air to EPS equipmetn for Level 1 EPSS. [See 110- (Log #28)]

Renumber 5-7.6 thru 5-7.8 as 5-7.5 to 5-7.7.

A-5.7.1 During operation, EPS and related equipment reject considerable heat that needs to be removed by proper ventilation or air-cooling. In some cases, outdoor installations rely on natural air circulation, but enclosed installations need properly sized, properly positioned ventilation facilities to prevent recirculation of cooling air. The optimum position of air supply louvers and radiator air discharge are on opposite walls, both to the outdoors.

COMMITTEE STATEMENT: Editorial. See Committee Proposal 110-53 (Log #CP22). A-5-7.5 was redundant to other proposed language. Also see Committee Statement on Proposal 110-26 (Log #28).

NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21

VOTE ON COMMITTEE ACTION:

AFFIRMATIVE: 16

NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters

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(Log #CP9)

110- 25 - (5-7.1): Accept

SUBMITTER: Technical Committee on Emergency Power Supplies

RECOMMENDATION: Review text of Paragraph 5-7.1 for vague/unenforceable text (i.e., consideration, properly) and revise.

SUBSTANTIATION: This proposal was generated as a result of an editorial review of this document. The recommendation contains recommended editorial changes that resulted from editing at the pamphlet stage of the last code cycle that require committee review and action.

COMMITTEE ACTION: Accept.
COMMITTEE STATEMENT: See Committee Action on Proposal 110-24 (Log #2).
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 16
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters

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(Log #28)

110- 26 - (5-7.2.1 through 5-7.2.3 (New)): Accept in Principle
SUBMITTER: Thomas L. Caisse, Robert M. Currey & Assoc., Inc.
RECOMMENDATION: Add new text as follows:
5-7.2.1 For EPS supplying Level 1 EPSS, ventilation air shall be supplied directly from a source outside of the building by an exterior wall opening or from a source outside the building by a 2-hour fire rated air transfer system.
5-7.2.2 For EPS supplying Level 1 EPSS, discharge air shall be directed outside of the building by an exterior wall opening or to an exterior opening by a 2-hour fire rated air transfer system.
5-7.2.3 Fire dampers, shutters, or other self closing devices shall not be installed in ventilation openings or ductwork for supply or return/discharge air to EPS equipment for Level 1 EPSS.
SUBSTANTIATION: In many instances EPS equipment supplying Level 1 EPSS are located within the building which is served by the Level 1 EPSS and are provided with ventilation air from adjacent spaces within the building through wall louvers or via ductwork that run through adjacent spaces from an external source. In order to comply with Section 5-2.1 of this document the EPS is required to be in a room with 2-hour fire rated construction, which in turn requires the openings in walls or to the ductwork running through the building to have fire dampers/shutters installed. With this arrangement it is foreseeable that an emergency which has called on the EPS to operate, such as a fire in an adjacent space, could cause the closure devices to operate thus defeating the Level 1 EPSS.
I also know of cases where the fire shutters activated due to a fusible link failure in the discharge louvers, which in turn caused a rapid failure of the system on an over temperature condition during load bank testing.
By specifically requiring dedicated ventilation and discharge systems directly to and from the outside of the building as suggested above, the intent of Section 5-2.1 as well as 5-7 can be met.
COMMITTEE ACTION: Accept in Principle.
Revise to read as follows:
5-7.2.1 For EPS supplying Level 1 EPSS, ventilation air shall be supplied directly from a source outside of the building by an exterior wall opening or from a source outside the building by a 2-hour fire rated air transfer system.
5-7.2.2 For EPS supplying Level 1 EPSS, discharge air shall be directed outside of the building by an exterior wall opening or to an exterior opening by a 2-hour fire rated air transfer system.
5-7.2.3 Fire dampers, shutters, or other self closing devices shall not be ~~installed~~ permitted in ventilation openings or ductwork for supply or return/discharge air to EPS equipment for Level 1 EPSS.
COMMITTEE STATEMENT: See Committee Action on Proposal 110-24 (Log #2).
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 16
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters

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(Log #CP10)

110- 27 - (5-7.4): Accept
SUBMITTER: Technical Committee on Emergency Power Supplies
RECOMMENDATION: Review text of Paragraph 5-7.4 for vague/unenforceable text (i.e., adequate) and revise.
SUBSTANTIATION: This proposal was generated as a result of an editorial review of this document. The recommendation contains recommended editorial changes that resulted from editing at the pamphlet stage of the last code cycle that require committee review and action.
COMMITTEE ACTION: Accept.
COMMITTEE STATEMENT: See Committee Action on Proposal 110-24 (Log #2).
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 16
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters

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(Log #29)

110- 28 - (5-7.4.1, 5-7.4.2 (New)): Accept in Principle
SUBMITTER: Thomas L. Caisse, Robert M. Currey & Assoc., Inc.
RECOMMENDATION: Add new text as follows:
5-7.4.1 For EPS supplying Level 1 EPSS, combustion air shall be supplied directly from a source outside of the building by an exterior wall opening or from a source outside the building by a 2-hour fire rated air transfer system.
5-7.4.2 Fire dampers, shutters, or other self closing devices shall not be installed in openings or ductwork used to supply combustion air to EPS equipment for Level 1 EPSS.
SUBSTANTIATION: In many instances EPS equipment supplying Level 1 EPSS are located within the building which is served by the Level 1 EPSS and are provided with ventilation air from adjacent spaces within the building through wall louvers or via ductwork that run through adjacent spaces from an external source. In order to comply with Section 5-2.1 of this document the EPS is required to be in a room with 2-hour fire rated construction, which in turn requires the openings in walls or to the ductwork running through the building to have fire dampers/shutters installed. With this arrangement it is foreseeable that an emergency which has called on the EPS to operate, such as a fire in an adjacent space, could cause the closure devices to operate thus defeating the Level 1 EPSS.
By specifically requiring dedicated combustion air supply systems from the outside of the building as suggested above, the intent of Section 5-2.1 as well as 5-7 can be met.
COMMITTEE ACTION: Accept in Principle.
COMMITTEE STATEMENT: See Committee Action on Proposal 110-24 (Log #2).
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 16
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters

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(Log #CP11)

110- 29 - (5-7.5): Accept
SUBMITTER: Technical Committee on Emergency Power Supplies
RECOMMENDATION: Review text of Paragraph 5-7.5 for vague/unenforceable text (i.e., consideration) and revise.
SUBSTANTIATION: This proposal was generated as a result of an editorial review of this document. The recommendation contains recommended editorial changes that resulted from editing at the pamphlet stage of the last code cycle that require committee review and action.
COMMITTEE ACTION: Accept.
COMMITTEE STATEMENT: See Committee Action on Proposal 110-24 (Log #2).
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 16
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters

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(Log #16)

110- 30 - (5-7.5): Accept in Principle in Part
SUBMITTER: Lawrence A. Bey, Onan Corp.
RECOMMENDATION: Add: When motor-operated dampers or louvers are used in the air flow path, they shall be spring operated to the open position and motor closed. Motor-operated dampers and louvers shall be signaled to open when or before the engine begins cranking to start.
SUBSTANTIATION: Motor-operated dampers and louvers required to open for engine operation must be capable of opening without electrical power.
COMMITTEE ACTION: Accept in Principle in Part.
COMMITTEE STATEMENT: See Committee Action on Proposal 110-24 (Log #2). The second sentence is rejected, absent of substantiation to convey its purpose or need.
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 16
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters
COMMENT ON AFFIRMATIVE:
STYMIEST: I agree with the submitter's second sentence and believe that it should be included in NFPA 110. However, I also do not believe that the proposal should be rejected without it.

(Log #17)

110- 31 - (5-7.6, 5-7.7): Accept in Principle
SUBMITTER: Lawrence A. Bey, Onan Corp.
RECOMMENDATION: Revise text as follows:
5-7.6 Provision shall be made to maintain the ambient air temperature in the EPS equipment room or outdoor housing containing Level 1 rotating equipment at ~~a temperature not less than 70°F (21°C), where the engine water jacket temperature is maintained at the levels specified in Chapter 3, at~~ not less than 40°F (4.5°C) nor more than the maximum temperature recommended by the manufacturer. ~~or the authority having jurisdiction.~~
Delete 5-7.7.
SUBSTANTIATION: The minimum ambient temperature for the EPS should be the same regardless of whether the EPS is installed indoors or located outdoors in a housing. The authority having jurisdiction should not be able to enforce a maximum temperature other than that recommended by the generator set manufacturer.
COMMITTEE ACTION: Accept in Principle.
Revise text to read as follows:
5-7.6 The ambient air temperature in the EPS equipmetn room or outdoor housing containing Level 1 rotating equipment shall be not less than 4.5°C (40°F).
COMMITTEE STATEMENT: See Committee Proposal 110-53 (Log #CP22).
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 16
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters

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(Log #CP12)

110- 32 - (5-7.8): Accept
SUBMITTER: Technical Committee on Emergency Power Supplies
RECOMMENDATION: Review text of Paragraph 5-7.8 for vague/unenforceable text (i.e., consideration) and revise.
SUBSTANTIATION: This proposal was generated as a result of an editorial review of this document. The recommendation contains recommended editorial changes that resulted from editing at the pamphlet stage of the last code cycle that require committee review and action.
COMMITTEE ACTION: Accept.
COMMITTEE STATEMENT: See Committee Proposal 110-53 (Log #CP22).
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 16
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters

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(Log #CP13)

110- 33 - (5-8.3): Accept
SUBMITTER: Technical Committee on Emergency Power Supplies
RECOMMENDATION: Review text of Paragraph 5-8.3 for vague/unenforceable text (i.e., considered) and revise.
SUBSTANTIATION: This proposal was generated as a result of an editorial review of this document. The recommendation contains recommended editorial changes that resulted from editing at the pamphlet stage of the last code cycle that require committee review and action.
COMMITTEE ACTION: Accept.
COMMITTEE STATEMENT: See Committee Proposal 110-53 (Log #CP22).
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 16
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters

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(Log #CP14)

110- 34 - (5-8.5): Accept
SUBMITTER: Technical Committee on Emergency Power Supplies
RECOMMENDATION: Review text of Paragraph 5-8.5 for vague/unenforceable text (i.e., consideration) and revise.
SUBSTANTIATION: This proposal was generated as a result of an editorial review of this document. The recommendation contains recommended editorial changes that resulted from editing at the pamphlet stage of the last code cycle that require committee review and action.
COMMITTEE ACTION: Accept.
COMMITTEE STATEMENT: See Committee Proposal 110-53 (Log #CP22).
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 16
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters

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(Log #3)

110- 35 - (5-9.1, 5-9.6 and 5-9.12): Accept in Part
SUBMITTER: Southern Regional Fire Code Dev. Committee
RECOMMENDATION: Add a new 5-9.1 to read:
5-9.1 All fuel tanks and systems shall be installed and maintained in accordance with NFPA 30, 37, 54, and 58. (renumber the remaining)
Add a new 5-9.13 to read:
5-9.13 All subbase tanks shall be listed for aboveground use in accordance with NFPA 30 and shall be equipped with spill control equipment as required by NFPA 30, 2-3.4.1.
Delete 5-9.6 in its entirety.
SUBSTANTIATION: The deletion of 5-9.6 and replacing it with a new 5-9.1 better clarifies and correctly places the charging language at the beginning of the chapter. The proposed 5-9.13 clarifies that all subbase tanks need to be listed per NFPA 30. This is for consistency with NFPA 30 which specifically deals with flammable and combustible liquids.
COMMITTEE ACTION: Accept in Part.
Renumber 5-9.1 as 5-9.1.1.
Reject 5-9.13.
Accept deletion of 5-9.6.
COMMITTEE STATEMENT: Proposed 5-9.13 is addressed by new language in 5-9.1.1.
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 16
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters

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(Log #CP15)

110- 36 - (5-9.2): Accept
SUBMITTER: Technical Committee on Emergency Power Supplies
RECOMMENDATION: Review text of Paragraph 5-9.2 for vague/unenforceable text (i.e., adequate) and revise.
SUBSTANTIATION: This proposal was generated as a result of an editorial review of this document. The recommendation contains recommended editorial changes that resulted from editing at the pamphlet stage of the last code cycle that require committee review and action.
COMMITTEE ACTION: Accept.
Rewrite 5-9.2 as follows:
"Fuel tanks shall be close enough to the prime mover for the fuel lift (suction head) of the prime mover fuel pump to meet the fuel system requirements or provide a fuel transfer pump and day tank."
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 16
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters

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(Log #CP16)

110- 37 - (5-10.3): Accept
SUBMITTER: Technical Committee on Emergency Power Supplies
RECOMMENDATION: Review text of Paragraph 5-10.3 for vague/unenforceable text (i.e., consideration) and revise.
SUBSTANTIATION: This proposal was generated as a result of an editorial review of this document. The recommendation contains recommended editorial changes that resulted from editing at the pamphlet stage of the last code cycle that require committee review and action.
COMMITTEE ACTION: Accept.
COMMITTEE STATEMENT: See Committee Proposal 110-53 (Log #CP22).
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 16
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters

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(Log #CP17)

110- 38 - (5-10.4): Accept
SUBMITTER: Technical Committee on Emergency Power Supplies
RECOMMENDATION: Review text of Paragraph 5-10.4 for vague/unenforceable text (i.e., consideration) and revise.
SUBSTANTIATION: This proposal was generated as a result of an editorial review of this document. The recommendation contains recommended editorial changes that resulted from editing at the pamphlet stage of the last code cycle that require committee review and action.
COMMITTEE ACTION: Accept.
COMMITTEE STATEMENT: See Committee Proposal 110-53 (Log #CP22).
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 16
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters

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(Log #19)

110- 39 - (5-11.2): Accept
SUBMITTER: Charles D. Hughes, Westinghouse Savannah River Company
RECOMMENDATION: Delete the last sentence of 5-11.2.
SUBSTANTIATION: The current wording requiring hoods and shields appears to be a conflict between NFPA 110 and NFPA 13. An effective guard or shield would negate the sprinkler system. It is not logical that I would require the use of sprinklers and then require the equipment to be protected from them.
COMMITTEE ACTION: Accept.
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 16
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters

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(Log #CP18)

110- 40 - (5-11.4): Accept
SUBMITTER: Technical Committee on Emergency Power Supplies
RECOMMENDATION: Review text of Paragraph 5-11.4 for vague/unenforceable text (i.e., adequately) and revise.
SUBSTANTIATION: This proposal was generated as a result of an editorial review of this document. The recommendation contains recommended editorial changes that resulted from editing at the pamphlet stage of the last code cycle that require committee review and action.
COMMITTEE ACTION: Accept.
COMMITTEE STATEMENT: See Committee Proposal 110-53 (Log #CP22).
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 16
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters

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(Log #CP19)

110- 41 - (5-13.2.5): Accept
SUBMITTER: Technical Committee on Emergency Power Supplies
RECOMMENDATION: Review text of Paragraph 5-13.2.5 for vague/unenforceable text (i.e., acceptable) and revise.
SUBSTANTIATION: This proposal was generated as a result of an editorial review of this document. The recommendation contains recommended editorial changes that resulted from editing at the pamphlet stage of the last code cycle that require committee review and action.
COMMITTEE ACTION: Accept.
COMMITTEE STATEMENT: See Committee Proposal 110-53 (Log #CP22).
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 16
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters

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(Log #CP20)

110- 42 - (6-2.4): Accept
SUBMITTER: Technical Committee on Emergency Power Supplies
RECOMMENDATION: Review text of Paragraph 6-2.4 for vague/unenforceable text (i.e., consideration) and revise.
SUBSTANTIATION: This proposal was generated as a result of an editorial review of this document. The recommendation contains recommended editorial changes that resulted from editing at the pamphlet stage of the last code cycle that require committee review and action.
COMMITTEE ACTION: Accept.
COMMITTEE STATEMENT: See Committee Proposal 110-53 (Log #CP22).
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 16
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters

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(Log #CP21)

110- 43 - (6-3.1): Accept
SUBMITTER: Technical Committee on Emergency Power Supplies
RECOMMENDATION: Review text of Paragraph 6-3.1 for vague/unenforceable text (i.e., reasonable) and revise.
SUBSTANTIATION: This proposal was generated as a result of an editorial review of this document. The recommendation contains recommended editorial changes that resulted from editing at the pamphlet stage of the last code cycle that require committee review and action.
COMMITTEE ACTION: Accept.
COMMITTEE STATEMENT: See Committee Proposal 110-53 (Log #CP22).
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 16
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters

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(Log #25)

110- 44 - (6-3.2): Reject
SUBMITTER: Dan Chisholm, Healthcare Circuit News
RECOMMENDATION: Insert as the last sentence:
The operational test shall be initiated at an automatic transfer switch and shall include testing of each EPSS component, including the transfer of each automatic and manual transfer switch to the alternate power source, for a period of not less than 30 minutes under operating temperature.
SUBSTANTIATION: There have been recent failures where maintenance personnel have only tested repaired components and not the entire EPSS.
NOTE: Supporting material is available for review at NFPA Headquarters.
COMMITTEE ACTION: Reject.
COMMITTEE STATEMENT: Testing the entire system after any modification to the EPSS is excessive.
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 14
NEGATIVE: 2
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters
EXPLANATION OF NEGATIVE:
CHISHOLM: While testing each transfer switch may be excessive, testing all other components of the EPSS would not. I would suggest that a modification to this proposal be considered that would require at least one transfer switch to be used as a "test switch" for a simulated power outage, for a period of 30 minutes equal to or greater than 30 percent of the standby nameplate rating. In addition, if an ATS is the component being repaired, it should be used as the "test switch".
JOHNSON: I agree with the Chisholm comment. The proposal should have been accepted in part to require a full system test starting from the repaired transfer switch or from any one transfer switch if the repair is of some other nature.

(Log #22)

110- 45 - (6-3.6): Accept in Principle
SUBMITTER: Dan Chisholm, Healthcare Circuit News
RECOMMENDATION: Insert the following text:
"A battery load test shall be performed quarterly by placing a recording voltmeter across the terminals of each starting (cranking) battery while the EPS is started. A voltage drop of more than 20 percent of nominal voltage shall be reason to investigate the integrity of the battery."
Move last sentence of existing paragraph to the last sentence of 6-3.6.
SUBSTANTIATION: Load tests have proven to be the only test that will consistently predict the failure of a starting battery, or the presence of other conditions such as a cold engine that can prevent an EPS from starting.
COMMITTEE ACTION: Accept in Principle.
Move to the Annex.
Modify the recommendation as follows:
"~~A~~ battery load test ~~shall~~ should be performed quarterly by placing a recording voltmeter across the terminals of each starting (cranking) battery while the EPS is started. ~~A~~ An excessive voltage drop of more than 20 percent of nominal voltage ~~shall~~ should be reason to investigate the integrity of the battery."
A.6.3.6 For existing systems that do not meet the requirements of Table 3-5.5.2(d) (l) a.....
COMMITTEE STATEMENT: The committee believes it is a valid test to perform, but not mandatory.
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 16
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters

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(Log #23)

110- 46 - (6-3.6): Accept
SUBMITTER: Dan Chisholm, Healthcare Circuit News
RECOMMENDATION: Revise text as follows:
"...shall be inspected weekly ~~at intervals of not more than 7 days~~ and shall be maintained in full compliance with manufacturer's specifications. Defective batteries shall be ~~repaired or~~ replaced..."
SUBSTANTIATION: Inspecting batteries on the same day of the week each week is impractical. Weekly inspections give the same latitude now given to testing the EPS monthly, versus every 30 days. Repairing batteries is not for the faint of heart.
COMMITTEE ACTION: Accept.
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 16
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters

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(Log #18)

110- 47 - (6-4.2.3, A-6-4.2.3 (New)): Accept in Principle
SUBMITTER: Lawrence A. Bey, Onan Corp.
RECOMMENDATION: Add the following:
6-4.2.3 The EPS shall be exercised for the duration of its assigned class (see 2-2.3), or for a duration agreed to by the authority having jurisdiction not to exceed 6 hours, at least once annually under the conditions required by this section. This annual exercise period shall be permitted in lieu of one of the required monthly exercise periods.
A-6-4.2.3 The intent of this requirement is to provide reasonable assurance that the EPS with all of its auxiliary subsystems is capable of running for the duration of its assigned class. The authority having jurisdiction may use judgment where exercising for the entire duration of the assigned class only demonstrates the capacity of the fuel supply.
SUBSTANTIATION: There have been problems with installations that exercise for 30 minutes once a month and then during an actual normal power failure discover that the generator set shuts down after running just past 30 minutes, due to a restricted radiator for example. Exercise once annually for the duration of the assigned class should give reasonable assurance the generator set will run beyond 30 minutes, for the intended duration of emergency power.
COMMITTEE ACTION: Accept in Principle.
Revise text so it now reads as follows and place in the Annex:
6-4.2.3 The EPS should be exercised for the duration of its assigned class (see 2-2.3), or for a duration agreed to by the authority having jurisdiction not to exceed 6 hours, at least once annually under the conditions required by this section.
The intent of this requirement is to provide reasonable assurance that the EPS with all of its auxiliary subsystems is capable of running for the duration of its assigned class.
COMMITTEE STATEMENT: The committee believes this is a good idea, but for some organizations this requirement would be an excessive and compromising test.

NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 16
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters

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(Log #30)

110- 48 - (A-3-2.1 (New)): Reject
SUBMITTER: Scott A. Stookey, Austin, TX
RECOMMENDATION: Add a new appendix note to NFPA 110 as follows:
A-3-2.1 The Standard for Stationary Engine Generator Assemblies, UL 2200, includes construction and performance requirements to verify the ability of energy converters to survive under common and abnormal disturbances in actual load circuits. Products that comply with this standard have also been investigated for additional safety and performance requirements.
SUBSTANTIATION: Chapter 3 identifies the construction and performance requirements for energy converters under a variety of conditions. In particular, Section 3-2.1 requires energy converters, and their controls and accessories to survive without damage, "common and abnormal disturbances in actual load circuits." No additional information is provided to clarify the nature of these disturbances. It is therefore up to the code user to determine what constitutes these disturbances, which can lead to some very subjective interpretations of this requirement.
At the request of many authorities having jurisdiction, UL developed a standard to evaluate the safety aspects of stationary engine generator assemblies. This standard, UL 2200, was first published in September, 1998. In addition to safety criteria, it evaluates the survivability of the unit under disturbances in the load circuit (3-2.1). It also evaluates many of the performance aspects covered in Chapter 3 of NFPA 110, as noted in the proposed appendix note.
The proposed reference to UL 2200 is intended to provide the code user with a more objective and definitive approach for determining compliance with Chapter 3 requirements.
COMMITTEE ACTION: Reject.
COMMITTEE STATEMENT: The committee approved listing under Proposal 110-6 (Log #6), but UL 2200 is not an ANSI standard at this time.
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 15
NEGATIVE: 1
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters
EXPLANATION OF NEGATIVE:
BEY: This proposal should be accepted as an new Appendix C-1.2.3. No where does the NFPA say that all referenced standards must be ANSI.
COMMENT ON AFFIRMATIVE:
CHISHOLM: The submitter's recommendation does not agree with commentary received from UL. In addition, if UL has indeed "investigated for additional safety and performance requirements", then UL's protocols should be investigated since OSHA standards have been ignored.
In the submitter's substantiation, he states: "At the request of many authorities...". I have asked UL on several occasions to show me a list of these authorities. I have not seen the first one so I suspect this is hearsay.
The submitter also states that UL 2200 "...evaluates many of the performance aspects covered in Chapter 3 of NFPA 110..." So why do we need another standard?
The acceptance of this proposal would have been nothing more than a free advertisement for UL. I whole heartily agree with the Committee's rejection.

(Log #12)

110- 49 - (A-4-2.4.9): Accept
SUBMITTER: Lawrence A. Bey, Onan Corp.
RECOMMENDATION: Delete A-4-2.4.9.
SUBSTANTIATION: While this is a true statement, it is no longer appropriate given that all Level 1 and 2 transfer switches shall be transferred during exercise.
COMMITTEE ACTION: Accept.
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 16
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters

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(Log #26)

110- 50 - (A-5-9.1): Accept in Principle
SUBMITTER: Dan Chisholm, Healthcare Circuit News
RECOMMENDATION: Revise text as follows:
"Fuel system design ~~should consider~~ shall provide for the safe provision of an adequate supply of clean, fresh fuel to the prime mover. ~~Diesel fuel has a storage life of approximately 1 1/2 to 2 years, and gasoline has a storage life of approximately 6 months.~~ Tanks ~~shall~~ should be sized so that the fuel is consumed within the storage life, or provision ~~shall~~ should be made to replace stale fuel with fresh fuel."
Remove A-5-9.1 from the appendix and insert proposed text at 5-9.1.1.
SUBSTANTIATION: "Dirty" fuel is the leading cause of EPS failures during extended runs, and the second leading cause of EPSs failing to start. Chevron, in its publication "Diesel Fuels Technical Review" (FTR-2), copyright 1998, states: "...If diesel fuel is stored for use in an emergency, it should be used within one year and replaced with fresh fuel, unless special precautions are taken. While storage stability should not be a concern for a majority of diesel fuel users, those who store diesel fuel for a prolonged period, i.e., one year or longer, can take steps to maintain fuel integrity. The actions listed below provide increasing levels of protection:
1. Purchase clean, dry fuel from a reputable supplier. Keep the stored fuel cool and dry. The presence of free water encourages corrosion of metal storage tanks and provides the medium for microbiological growth.
2. Add an appropriate stabilizer that contains an antioxidant, biocide, and corrosion inhibitor.
3. Use a fuel quality management service to regularly test the fuel, and as necessary, polish it — by filtration through portable filters — and add fresh stabilizer. This is common practice for nuclear power plants with back-up diesel powered generators.
4. Install a dedicated fuel quality management system that automatically tests and purifies the fuel and injects fresh stabilizer."
COMMITTEE ACTION: Accept in Principle.
Revise as follows:
5.9.1.2* Fuel system design ~~should consider~~ shall provide for a supply of ~~the safe provision of an adequate supply of~~ clean ~~fresh~~ fuel to the prime mover. ~~Diesel fuel has a storage life of approximately 1 1/2 to 2 years, and gasoline has a storage life of approximately 6 months.~~
5.9.1.3 Tanks ~~shall~~ should be sized so that the fuel is:
(1) Consumed within the storage life, or
(2) Provisions made to replace stale fuel, or
(3) Clean fuel
A.5.9.1.2 Add ASTM Fuel Oil Rating Table as follows:

	Fuel Oil Rating (diesel)
A-2	Refinery fresh fuel
A-3	Good
A-4	Watch closely - aging has begun
A-5	Advanced aging and oxidization
A-6	Badly aged - not recommended
A-7	Severe aging - do not use.

COMMITTEE STATEMENT: Editorial. See Committee Proposal 110-53 (Log #CP22).
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 16
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters

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(Log #1)

110- 51 - (A-5-9.7 (New)): Accept in Principle
SUBMITTER: Northcentral Regional Fire Code Dev. Committee
RECOMMENDATION: Add a new A-5-9.7 to read:
A-5-9.7 Valving for natural gas-fueled prime movers shall be configured so that the gas supply to the prime mover cannot be inadvertently or intentionally shut off by anyone other than the qualified personnel such as the gas supplier. Placing valves in an isolated area, a secure area or locking the valve(s) open shall be permitted.
SUBSTANTIATION: While there may be many valves on a gas supply system, there are typically three valves affecting supply to the generator; 1. The gas company service valve, 2. The generator supply valve, 3. The main building supply valve. The first two must be protected against shut off so that gas is always available to the generator. This code section attempts to do so.
COMMITTEE ACTION: Accept in Principle.
Revise to read as follows:
A-5-9.7 Valving for natural gas-fueled prime movers should be configured so that the gas supply to the prime mover cannot be inadvertently or intentionally shut off by anyone other than the qualified personnel such as the gas supplier. Placing valves in an isolated area, a secure area or locking the valve(s) open is recommended.
COMMITTEE STATEMENT: Replace mandatory language for placement in annex.
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 16
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters

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(Log #24)

110- 52 - (A-6-3.6): Accept in Principle
SUBMITTER: Dan Chisholm, Healthcare Circuit News
RECOMMENDATION: Revise text as follows:
"Maintenance of batteries ~~should~~ shall include the monthly checking and recording ~~the value~~ of ~~the~~ electrolyte specific gravity. ~~[See NFPA 70, National Electrical Code, Section 700-4(c).]~~"
Remove text from appendix and insert revised text in Paragraph 6-3.6.
SUBSTANTIATION: Checking the level of electrolyte in each cell only verifies that electrolyte actually resides in the cell, not the quality of the electrolyte. Therefore, a system of checking the "state of charge" of the battery while the EPS is in the off position is needed.
COMMITTEE ACTION: Accept in Principle.
Revise to read as follows:
"Maintenance of lead acid batteries shall include the monthly checking and recording of electrolyte specific gravity."
COMMITTEE STATEMENT: The type of battery associated with the type of test needed to be defined.
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 16
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters

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(Log #CP22)

110- 53 - (Entire Document): Accept
SUBMITTER: Technical Committee on Emergency Power Supplies
RECOMMENDATION: The Technical Committee on Emergency Power proposes a complete revision to NFPA 110, Standard for Emergency and Standby Power Systems, 1999 edition as shown at the end of this report, incorporating proposals, to comply with the Manual of Style.
SUBSTANTIATION: The revision, incorporating proposals and editorial restructuring, is accomplished to conform with the April 2000 NFPA Manual of Style (MOS).
COMMITTEE ACTION: Accept.
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 21
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 14
NEGATIVE: 2
NOT RETURNED: 5 Burgess, Everard, O'Connor, Stillman, Watters
EXPLANATION OF NEGATIVE:
DeLERNO: I cannot support this proposal. It conflicts with specific proposal action in some cases. Note that the recommendation (of 110-53) states that the text at the end of this report "incorporating proposals" to comply with the Manual of Style. There is at least one (and maybe more) text revisions with no technical support for change from existing text (see 5-2.4.1).
JOHNSON: I am voting negative because of the large number of editorial errors and some that are not editorial. It is very difficult and time consuming to tie proposals 110-2, etc., to the revised text. The proposal should have referred to the paragraph in the revised text as well as the original. I had only six days to review the proposals, coordinate with my alternate, who was on vacation, to obtain approval from my sponsor IEEE and get the ballot to NFPA. I found a number of errors in the text with a very cursory review. I do not feel confident that there are not many more. Here are the ones I noted:
Table 2.2.2 Type U is strangely separated. Actually there should not be a type U. That is in NFPA 111.
Table 2.2.3 Classes 0.083 and 0.25 are not covered in this standard.
3.2.3(5) Word "and" should be deleted.
3.2.3(6) Word "adverse" belongs in (7).
3.2.3(7) Number (7) should be moved in front of "adverse" at the end of (6) and be on a separate line.
3.6.3.1 Add clause "that is acceptable for the load" at the end of the sentence.
Table 3.6.4.2 Reference to 3.5.4.2 following the * is incorrect. There is no 3.5.4.2.
3.6.4.5.7 Add "valve-regulated" in front of "maintenance-free" and enclose (maintenance-free). Valve-regulated is defined in Chapter 2 but does not appear in the text.
3.5.7(1) Word "convection" is out of place. Should be "natural convection...".
4.2.12 Space missing between "shutdown" and "to".
4.2.17 Space missing between "grounded" and "to".
5.2.7 The number 30 should be 36.
5.4.1.1(1) The metric value should be in front. This is also true in a number of other places.
5.7.4 The sentence makes no sense. Change "or" after "cooling" to "with".
5.7.7 Metric temperature should be first.
5.95 Metric measurement should be first in (1) and (2).
5.9.11 Strike "(3) or both."
5.9.13 Metric should be first.
5.9.1.3.1 Metric should be first.
5.10.5 Heading should not be the same as 5.10.
COMMENT ON AFFIRMATIVE:
BEY: Editorial comment: Table 3-5.5.2: An indicator function for (h) Low Fuel Main Tank was somehow inadvertently dropped between the 1996 and 1999 editions. It needs to be put back in.
STYMIEST: I voted negatively on Proposal 110-6, and this comment reflects that vote.

NFPA 110

Standard for

Emergency and Standby Power Systems

2002 Edition

NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates that explanatory material on the paragraph can be found in Annex A.

Information on referenced publications can be found in Chapter 7 and Annex C.

Chapter 1 Administration

1.1 Scope. This standard covers performance requirements for power systems providing an alternate source of electrical power to loads in buildings and facilities in the event that the primary power source fails.

1.1.1 Power systems covered in this standard include power sources, transfer equipment, controls, supervisory equipment, and all related electrical and mechanical auxiliary and accessory equipment needed to supply electrical power to the load terminals of the transfer equipment.

1.1.2 This standard covers installation, maintenance, operation, and testing requirements as they pertain to the performance of the emergency power supply system (EPSS).

1.1.3 This standard does not cover the following:

(1) The application of the EPSS
(2) Emergency lighting unit equipment
(3) Distribution wiring
(4) Utility service, when such service is permitted as the EPSS
(5) Parameters for stored energy devices

1.1.4* This standard does not establish criteria for stored energy systems.

1.1.5 The selection of any of the following is not within the scope of this standard:

(1) Specific buildings or facilities, or both, requiring an EPSS
(2) Specific loads to be served by the EPSS
(3)* Assignment of type, class, or level to any specific load

1.2 Purpose. This standard contains performance requirements for an EPSS.

1.2.1 It is the role of other NFPA standards to specify which occupancies require an EPSS and the applicable level, type, and class. This standard does not specify where an EPSS is required.

1.2.2 This standard also is intended to provide guidance for inspectors, designers, installers, manufacturers, and users of EPSSs and to serve as a vehicle for communication between the parties involved. It is not intended as a design manual.

1.2.3 Compliance with this standard is not intended to exempt the parties involved from their respective responsibilities for the design, installation, maintenance, performance, or compliance with other applicable standards and codes.

1.3 Application. This document applies to new installations of EPSSs. Existing systems shall not (this language is okay) be required to be modified to conform, except where the authority having jurisdiction determines that nonconformity presents a distinct hazard to life.

1.4 Equivalency. Nothing in this document is intended to prevent the use of systems, methods, or devices of equivalent or superior quality, strength, fire resistance, effectiveness, durability, and safety to those prescribed by this standard. Technical documentation shall be submitted to the authority having jurisdiction to demonstrate equivalency. The system, method, or device shall be approved for the intended purposes by the authority having jurisdiction.

Chapter 2 Definitions

2.1 Definitions.

2.1.1* Approved. Acceptable to the authority having jurisdiction.

2.1.2* Authority Having Jurisdiction. The organization, office, or individual responsible for approving equipment, an installation, or a procedure.

2.1.3 Battery Certification. The certification by a battery manufacturer that a battery is built to industry standards.

2.1.4* Emergency Power Supply (EPS). The source of electric power of the required capacity and quality for an emergency power supply system (EPSS). The EPS includes all the related electrical and mechanical components of the proper size and/or capacity required for the generation of the required electrical power at the EPS output terminals.

2.1.5* Emergency Power Supply System (EPSS). A complete functioning EPS system coupled to a system of conductors, disconnecting means and overcurrent protective devices, transfer switches, and all control, supervisory, and support devices up to and including the load terminals of the transfer equipment needed for the system to operate as a safe and reliable source of electric power.

2.1.6 Labeled. Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

2.1.7 Lamp. An illuminating indicator.

2.1.8* Listed. Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets identified standards or has been tested and found suitable for a specified purpose.

2.1.9 Seismic Risk Areas. Intensities I through VII of the Modified Mercali Intensity Scale of 1931.

2.1.10 Shall. Indicates a mandatory requirement.

2.1.11 Should. Indicates a recommendation or that which is advised but not required.

2.1.12 Standard. A document, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and which is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions shall be located in an Annex, footnote, or fine-print note and are not to be considered a part of the requirements of a standard.

2.1.13 Switch.

2.1.13.1 Automatic Transfer Switch. Self-acting equipment for transferring one or more load conductor connections from one power source to another.

2.1.13.2 Bypass-Isolation Switch. A manually operated device used in conjunction with an automatic transfer switch to provide a means of directly connecting load conductors to a power source and disconnecting the automatic transfer switch.

2.1.13.3 Nonautomatic Transfer Switch. A device, operated by direct manpower or electrical remote manual control, for transferring one or more load conductor connections from one power source to another.

2.1.14 Fuel Tank.

2.1.14.1 Day Fuel Tank. A fuel tank, located inside a structure, that provides fuel to the engine.

2.1.14.2 Enclosed Fuel Tank. A fuel tank located within a separate room, separated from other equipment.

2.1.14.3 Integral Fuel Tank. A fuel tank furnished by the EPS manufacturer and mounted on the engine or the engine subbase.

2.1.14.4 Main Fuel Tank. A separate, main fuel tank for supplying fuel to the engine or a day tank.

2.1.15 Valve-Regulated (Sealed) Battery. A battery that is not provided with a means for replacing the evolved products of electrolysis.

2.2 Classification of Emergency Power Supply Systems (EPSSs).

2.2.1* General. The EPSS shall provide a source of electrical power of required capacity, reliability, and quality to loads for a length of time as specified in Table 2.2.1(a), and within a specified time following loss or failure of the normal power supply as specified in Table 2.2.1(b).

Table 2.2.1(a) Types of EPSSs

Type U	Basically uninterruptible (UPS systems)
Type 10	10 seconds
Type 60	60 seconds
Type 120	120 seconds
Type M	Manual stationary or nonautomatic — no time limit

Table 2.2.1(b) Classification of EPSSs

Class	Minimum Time
Class 0.083	0.083 hour (5 minutes)
Class 0.25	0.25 hour (15 minutes)
Class 2	2 hours
Class 6	6 hours
Class 48	48 hours
Class X	Other time, in hours, as required by the application, code, or user

2.2.2 Type. The EPSS shall be permitted to be without acceptable electrical power to the load terminals of the transfer switch for a maximum time, in seconds, as defined in Table 2.2.1(a).

2.2.3* Class. The EPSS shall operate at its rated load without being refueled for a minimum time, in hours, as defined in Table 2.2.1(b).

2.2.4* Level. Two levels of equipment installations, performance, maintenance, and testing shall be covered in this document.

2.2.4.1* Level 1 systems shall be installed when failure of the equipment to perform could result in loss of human life or serious injuries.

2.2.4.2* Level 2 systems shall be installed when failure of the EPSS to perform is less critical to human life and safety and where the authority having jurisdiction shall permit a higher degree of flexibility than provided by a Level 1 system.

2.2.4.3 All Level 1 and Level 2 equipment shall be permanently installed.

2.2.4.4* Level 1 and 2 systems shall ensure all loads served by the EPSS are supplied with alternate power

(1) Of a quality equivalent to commercial power or acceptable for the load
(2) Within the time specified for the type
(3) For a duration specified for the class

Chapter 3 Emergency Power Supply (EPS): Energy Sources, Converters, and Accessories

3.1 Energy Sources.

3.1.1 The following energy sources shall be permitted to be used for the emergency power supply (EPS):

(1)* Liquid petroleum products at atmospheric pressure
(2) Liquefied petroleum gas (liquid or vapor withdrawal)
(3) Natural or synthetic gas

3.1.2 Natural or synthetic gas for Level 1 installations, in locations where the probability of interruption of off-site fuel supplies is high (i.e., where earthquake, flood damage, or a demonstrated utility unreliability is likely), shall require on-site storage of an alternate energy source to allow for the full output of the emergency power supply system (EPSS) to be delivered for the class specified and with the provision for automatic transfer from the primary energy source to the alternate energy source.

3.1.3* The performance of a Level 1 EPSS in seismic risk areas shall be based on the EPS equipment's operating a minimum of 96 hours without refueling if the need for an EPS persists for this period of time.

3.1.4 The energy sources listed in 3.1.1 shall be permitted to be used for the EPS where the primary source of power is by means of on-site energy conversion, provided that there is separately dedicated energy conversion equipment on-site with a capacity equal to the power needs of the EPSS.

3.1.5* A public electric utility that has a demonstrated reliability shall be permitted to be used as the EPS where the primary source is by means of on-site energy conversion.

3.2 Energy Converters — General.

3.2.1 Energy converters shall consist only of rotating equipment as indicated in 3.2.4.

3.2.1.1 Level 1 energy converters shall be representative products built from components that have proven compatibility and reliability and are coordinated to operate as a unit.

3.2.1.2 The capability of the energy converter, with its controls and accessories, to survive common and abnormal disturbances in actual load circuits without damage shall be demonstrated by performance of either of the following:

(1) Tests on separate prototype models
(2) Acceptable tests on the system components as performed by the component suppliers

3.2.1.3 Where available, the generator set(s) shall be listed for emergency service as a completely factory assembled and factory tested apparatus.

3.2.1.4 A separate prototype unit shall be permitted to be utilized in a Level 1 or Level 2 installation, provided that all prototype tests produce no deleterious effects on the unit, and the authority having jurisdiction, the owner, and the user are informed that the unit is the prototype test unit.

3.2.2* The rotating equipment prototype unit shall be tested with all typical prime mover accessories that affect its power output in place and operating. These accessories include, but shall not be limited to, the following:

(1) Battery-charging alternator
(2) Water pump
(3) Radiator fan for unit-mounted radiators or oil coolers (or comparable load)
(4) Fuel pump and fuel filter(s)
(5) Air filter(s)
(6) Exhaust mufflers or restriction simulating the maximum backpressure recommended by the prime mover manufacturer

3.2.3 The energy converter for Level 1 systems shall be specifically designed, assembled, and tested to ensure system operation under the following conditions:

(1) Short circuits
(2) Load surges due to motor starting
(3) Elevator operations
(4) Silicon controlled rectifier (SCR) controllers
(5) X-ray equipment
(6) Overspeed, overtemperature, overload, and adverse
(7) Environmental conditions

3.2.4 Rotating equipment shall consist of a generator driven by one of the following prime mover types:

(1) Otto cycle (spark ignited)
(2) Diesel cycle
(3) Gas turbine cycle

3.2.4.1 Other types of prime movers and their associated equipment meeting the applicable performance requirements of this standard shall be permitted, if acceptable to the authority having jurisdiction.

3.2.4.2 Where used for Level 1 applications the prime mover shall not mechanically drive any equipment other than its operating accessories and its generator.

3.2.5 The EPS shall be installed in accordance with NFPA 70, *National Electrical Code®*.

3.3 Energy Converters — Temperature.

3.3.1 The EPS shall be heated as necessary to maintain the water jacket temperature determined by the EPS manufacturer for cold start and load acceptance for the type of EPSS.

3.3.2 Where an engine water jacket heater is required, it shall maintain the jacket water temperature at not less than 32°C (90°F).

3.3.3 Units housed outdoors shall have an automatically controlled heater to keep the jacket water temperature at not less than 32°C (90°F).

3.3.4 Provision shall be made for units housed outdoors to maintain the energy converter enclosure at not less than 0°C (32°F), or provide battery heaters to maintain battery temperature at a minimum of 10°C (50°F) that shall automatically shut off when the battery temperature reaches 32°C (90°F).

3.3.5 All prime mover heaters shall be automatically deactivated while the prime mover is running. *(For combustion turbines, see 5.7.6.)*

3.3.5.1 Air-cooled prime movers shall be permitted to employ a heater to maintain lubricating oil temperature as recommended by the prime mover manufacturer.

3.3.6 Antifreeze protection shall be provided according to the manufacturer's recommendations.

3.3.7 Ether-type starting aids shall not be permitted.

3.4* Energy Converters — Capacity. The energy converters shall have the required capacity and response to pick up and carry the load within the time specified in Table 2.2.1(a) after loss of primary power.

3.5 Energy Converters — Fuel Supply.

3.5.1 The fuel supplies specified in 3.1.1(1) and (2) for energy converters intended for Level 1 use shall not be used for any other purpose. *(For fuel system requirements see Section 5.9.)*

3.5.1.1 Enclosed tanks shall be permitted to be used for supplying fuel for other equipment, provided that the draw-down level will always guarantee the quantity needed for the EPSS.

3.5.1.2 Vapor-withdrawal LP-Gas systems shall have a dedicated fuel supply.

3.5.2* A low-fuel sensing switch shall be provided for the main fuel supply tank(s) using the energy sources listed in 3.1.1(1) and 3.1.1(2) to indicate when less than the minimum fuel necessary for full load running as required by the specified class in Table 2.2.1(b) remains in the main fuel tank.

3.5.3* The main fuel reservoir shall have a minimum capacity of at least 133 percent of either the low-fuel sensor quantity specified in 3.5.2, or that is specified in Table 2.2.1(b) (class).

3.6 Rotating Equipment.

3.6.1 General. Prime movers and accessories shall comply with NFPA 37, *Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines*, except as modified in this standard.

3.6.2 Prime Mover Ratings. Proper derating factors, such as altitudes, ambient temperature, fuel energy content, accessory losses, and site conditions as recommended by the manufacturer of the generator set shall be used in determining whether or not brake power meets the connected load requirements.

3.6.3 Prime Mover Accessories.

3.6.3.1 Governors shall maintain a bandwidth of rated frequency for any constant load (steady-state condition).

3.6.3.2 The frequency droop between no load and full load shall be within the range for the load.

3.6.3.3 The frequency dip upon one-step application of the full load shall not be outside the range for the load, with a return to steady-state conditions occurring within the requirements of the load.

3.6.3.4 Solenoid valves, where used, both in the fuel line from the supply or day tank closest to the generator set and in the water-cooling lines, shall operate from battery voltage.

3.6.3.5 Solenoid valves shall have a manual (nonelectric) operation, or a manual bypass valve shall be provided.

3.6.3.6 The manual bypass valve shall be visible and accessible and its purpose identified.

3.6.3.7 The fuel bypass valve shall not be the valve used for malfunction or emergency shutdown.

3.6.3.8 The prime mover shall be provided with the following instruments:

(a) Oil pressure gauge to indicate lubricating oil pressure. Engines with splash-lubricated systems shall not require this gauge.

(b) Temperature gauge to indicate cooling medium temperature. Air-cooled engines shall not require this gauge.

(c) Hour meter to indicate actual total running time.

(d) Battery-charging meter indicating performance of prime mover–driven battery charging means.

(e) Other instruments as recommended or provided by the prime mover manufacturer where required for maintenance.

3.6.3.9 The instruments required in 3.6.3.8(a), (b), (c), and (d) shall be placed on an enclosed panel, located in proximity to or on the energy converter, in a location that allows maintenance personnel to observe them readily without changing position from a logical maintenance work position at the energy converter.

The enclosed panel shall be mounted by means of antishock vibration mountings if mounted on the energy converter.

3.6.3.10 All wiring for connection to the control panel shall be harnessed or flexibly enclosed, shall be securely mounted on the prime mover to prevent chafing and vibration damage, and shall terminate at the control panel in an enclosed box or panel. *(For control panel requirements, see 3.6.5.)*

3.6.3.11 The generator set shall be fitted with an integral accessory battery charger, driven by the prime mover and automatic voltage regulator, capable of charging and maintaining the starting battery unit (and control battery, where used) in a fully charged condition during a running condition.

3.6.3.11.1 A battery charger driven by the prime mover shall not be required, provided the automatic battery charger has a high–low rate capable of fully charging the starting battery during running conditions as specified in 3.6.3.11.

3.6.4 Prime Mover Starting Equipment.

3.6.4.1 Starting Systems. Starting shall be accomplished using either an electric starter or stored energy starting system.

3.6.4.1.1 Electric starter systems shall start using a positive shift solenoid to engage the starter motor and to crank the prime mover for the period specified in 3.6.4.2 without overheating, at a speed at least equal to that recommended by the manufacturer of the prime mover and at the lowest ambient temperature anticipated at the installation site.

3.6.4.1.2 Other types of stored energy starting systems (except pyrotechnic) shall be permitted to be used where recommended by the manufacturer of the prime mover, and subject to approval of the authority having jurisdiction, under the following conditions:

(1) Where two complete periods of cranking cycles are completed without replacement of the stored energy
(2) Where a means for automatic restoration from the emergency source of the stored energy is be provided
(3) Where the stored energy system has the cranking capacity specified in 3.6.4.2.1
(4) Where the stored energy system has a "black start" capability in addition to normal discharge capability

3.6.4.2* Otto or Diesel Cycle Prime Movers. For otto or diesel cycle prime movers, the type and duration of the cranking cycle shall be as specified in Table 3.6.4.2.

Table 3.6.4.2 Required Starting Equipment

Starting Equipment		Level 1	Level 2
(a)	Battery unit	X	X
(b)	Battery certification	X	
(c)	Cycle cranking*	X or O	O
(d)	Cranking limiter time		
	Cycle crank (3 cycles)	75 sec	75 sec
	Continuous crank	45 sec	45 sec
(e)	Float-type battery charger	X	X
	1. dc ammeter	X	X
	2. dc voltmeter	X	X
(f)	Recharge time	24 hr	36 hr
(g)	Low battery voltage alarm contacts	X	X

X: Required
O: Optional
*See 3.6.4.2 for otto and diesel cycle requirements.

3.6.4.2.1 A complete cranking cycle shall consist of an automatic crank period of approximately 15 seconds followed by a rest period of approximately 15 seconds. Upon starting and running the prime mover, further cranking shall cease.

3.6.4.2.2 Two means of cranking termination shall be utilized so that one serves as backup to prevent inadvertent starter engagement.

3.6.4.2.3 Otto cycle prime movers of 15 kW and lower and all diesel prime movers shall be permitted to use continuous cranking methods.

3.6.4.3* Number of Batteries. Each prime mover shall be provided with both of the following:

(1) Storage battery units as specified in Table 3.6.4.2
(2) A storage rack for each battery or battery unit

3.6.4.4* Size of Batteries. The battery unit shall have the capacity to maintain the cranking speed recommended by the prime mover manufacturer through two complete periods of cranking limiter time-outs as specified in Table 3.6.4.2, item (d).

3.6.4.5 Type of Battery. The battery shall be of the nickel-cadmium or lead-acid type.

3.6.4.5.1* Lead-acid batteries shall be furnished as charged when wet. Drain-dry batteries or dry-charged lead-acid batteries shall be permitted.

3.6.4.5.2 When furnished, vented nickel-cadmium batteries shall be filled and charged and shall have listed flip-top, flame arrestor vent caps.

3.6.4.5.3 The manufacturer shall provide installation, operation, and maintenance instructions, and when shipped dry, electrolyte mixing instructions.

3.6.4.5.4 Batteries shall not be installed until the battery charger is in service.

3.6.4.5.5 All batteries used in this service shall have been designed for this duty, and shall have demonstrable characteristics of performance and reliability acceptable to the authority having jurisdiction.

3.6.4.5.6 Batteries shall be prepared for use according to the battery manufacturer's instructions.

3.6.4.5.7 Starting batteries for Level 1 installations shall not be of the maintenance-free variety.

3.6.4.6* Automatic Battery Charger. In addition to the prime mover–(engine–) driven charger required in 3.6.3.11.1, a battery charger(s) as required in Table 3.6.4.2 shall be supplied for recharging or maintaining a charge, or both, on the starting or control battery unit, or both.

3.6.4.7 All chargers shall include the following characteristics that are to be accomplished without manual intervention (i.e., manual switch or manual tap changing):

(a) At its rated voltage, the charger shall be capable of delivering energy into a fully discharged battery unit without damaging the unit.

(b) When specified, the charger shall be capable of returning to the fully discharged battery 100 percent of its ampere-hour rating within the time specified.

(c) Meters, as specified, with an accuracy within 5 percent of range shall be furnished to indicate the operation of the charger.

(d) The charger shall be permanently marked with the following:

(1) Allowable range of battery unit capacity

(2) Nominal output current and voltage

(3) Sufficient battery-type data to allow replacement batteries to be obtained

(e) The battery charger output and performance shall be compatible with the batteries furnished, including the maintenance charge rate.

3.6.5 Control Functions.

3.6.5.1 A control panel shall be provided and shall contain the following:

(a) Automatic remote start capability
(b) "Run-off-automatic" switch
(c) Shutdowns as required by 3.6.5.2(c)
(d) Alarms as required by 3.6.5.2(d)
(e) Controls as required by 3.6.5.2(e)

3.6.5.2 An automatic control and safety panel shall be a part of the EPS containing the following equipment or possess the following characteristics, or both:

(a) Cranking control equipment to provide the complete cranking cycle described in 3.6.4.2 and required by Table 3.6.4.2.

(b) A panel-mounted control switch(es) marked "run-off-automatic" to perform the following functions:

(1) Run: Manually initiate, start, and run prime mover
(2) Off: Stop prime mover or reset safeties, or both
(3) Automatic: Allow prime mover to start by closing a remote contact and stop by opening the remote contact

(c) Controls to shut down and lock out the prime mover under any of the following conditions:

(1) Failing to start after specified cranking time
(2) Overspeed
(3) Low lubricating-oil pressure
(4) High engine temperature
(5) Operation of remote manual stop station

An automatic engine shutdown device for high lubricating-oil temperature shall not be required.

(d) Individual alarm indication to annunciate of any of the conditions listed in Table 3.6.5.2 shall have the following characteristics:

(1) Battery powered
(2) Visually indicated
(3) Have additional contacts or circuits for a common audible alarm that signals locally and remotely when any of the itemized conditions occurs
(4) Have a lamp test switch(es) to test the operation of all alarm lamps

(e) Controls to shut down the prime mover upon removal of the initiating signal or manual emergency shutdown

(f) The ac instruments listed in 3.6.9.7

Where the control panel is mounted on the energy converter, it shall be mounted by means of antivibration shock mounts, if required, to maximize reliability.

Table 3-6.5.2 Safety Indications and Shutdowns

	Level 1			Level 2		
Indicator Function (at Battery Voltage)	**C.V.**	**S**	**R.A.**	**C.V.**	**S**	**R.A.**
(a) Overcrank	X	X	X	X	X	O
(b) Low water temp. <70°F (21°C)	X		X	X		O
(c) High engine temperature prealarm	X		X	O		
(d) High engine temperature	X	X	X	X	X	O
(e) Low lube oil pressure prealarm	X		X	O		
(f) Low lube oil pressure	X	X	X	X	X	O
(g) Overspeed	X	X	X	X	X	O
(h) Low fuel main tank	X		X	O		O
(i) EPS supplying load	X			O		
(j) Control switch not in auto. position	X		X	O		
(k) High battery voltage	X			O		
(l) Low Cranking Voltage	X		X	O		O
(m Low voltage in battery)	X			O		
(n) Battery charger ac failure	X			O		
(o) Lamp test	X			X		
(p) Contacts for local and remote common alarm	X		X	X		X
(q) Audible alarm silencing switch			X			O
(r) Low starting air pressure	X			O		
(s) Low starting hydraulic pressure	X			O		
(t) Air shutdown damper when used	X	X	X	X	X	O
(u) Remote emergency stop		X			X	

Key:
C.V.: Control panel-mounted visual indication
R.A.: Remote audible
S: Shutdown of EPS
X: Required
O: Optional

Additional Requirements to Table 3.6.5.2:
1. Item (o) shall be provided, but a separate remote audible signal shall not be required when the regular work site in 3.6.6.1 is staffed 24 hours a day.
2. Item (b) is not required for combustion turbines.
3. Item (q) or (r) shall apply only where used as a starting method.
4. Item (i): EPS ac ammeter shall be permitted for this function.
5. All required C.V. functions shall be visually annunciated by a remote, common visual indicator.
6. All required functions indicated in the R.A. column shall be annunciated by a remote, common audible alarm as required in 3-6.5.2(d).
7. Item (h) on gaseous systems shall require a low gas pressure alarm.
8. Item (b) shall be set at 11°C (20°F) below the regulated temperature determined by the EPS manufacturer as required in 3.3.1.

3.6.5.3 Engines equipped with a maintaining shutdown device (air shutdown damper) shall have a set of contacts that monitor the position of this device, with local alarm indication and remote annunciation in accordance with Table 3.6.5.2(d).

3.6.5.4 The control panel in 3.6.5.2(d) shall be specifically approved for either a Level 1 or a Level 2 EPS consistent with the installation.

3.6.5.5 The cranking cycle shall be capable of being initiated by any of the following:

(a) Manual start initiation as specified in 3.6.5.2(b)1.

(b) Loss of normal power at any automatic transfer switch considered a part of the EPSS. Prime mover shall start upon closing of a remote switch or contacts and shall stop, after appropriate time delays, when switch or contacts are opened.

(c) Clock exerciser located in an automatic transfer switch or in the control panel.

(d) Manually operated (test) switch located in each automatic transfer switch (ATS) that simulates a loss of power, and causes automatic starting and operation until this switch is reset, to cause the engine circuit to duplicate its functions in the same manner commercial power is restored after a true commercial power failure.

3.6.5.6* All Level 1 and Level 2 installations shall have a remote manual stop station of a type similar to a break-glass station located outside the room housing the prime mover, where so installed, or elsewhere on the premises where the prime mover is located outside the building.

3.6.6 Remote Controls and Alarms. A remote, common audible alarm shall be provided as specified in 3.6.5.2(d) that is powered by the storage battery and located outside of the EPS service room at a work site observable by personnel.

3.6.6.1 An alarm-silencing means shall be provided, and the panel shall include repetitive alarm circuitry so that, after the audible alarm has been silenced, it reactivates after the fault condition has been cleared and has to be restored to its normal position to be silenced again.

3.6.6.2 In lieu of the requirement of 3.6.6.1, a manual alarm-silencing means shall be permitted that silences the audible alarm after the occurrence of the alarm condition, provided such means do not inhibit any subsequent alarms from sounding the audible alarm again without further manual action.

3.6.7 Prime Mover Cooling Systems. Cooling systems for prime movers shall be either natural or forced-air convection, liquid-cooled, or a combination thereof.

3.6.7.1 Forced-air-cooled diesel or otto cycle engines shall have an integral fan selected to cool the prime mover under full load conditions.

3.6.7.2 Ventilation shall be provided for the evacuation of hot air from the EPS service room or the enclosure housing the unit.

3.6.7.3 Liquid-cooled prime movers for Level 1 applications shall be arranged for closed-loop cooling and consist of one of the following types as required in Section 5.8:

(a) Unit-mounted radiator and fan
(b) Remote radiator
(c) Heat exchanger (liquid-to-liquid)

3.6.7.4 Cooling systems shall prevent overheating of prime movers under conditions of highest anticipated ambient temperature at the installed elevation (above sea level) when fully loaded.

3.6.7.5 Power for fans and pumps on remote radiators and heat exchangers shall be supplied from a tap at the EPS output terminals, or ahead of the first load circuit overcurrent protective device.

3.6.7.6 The secondary side of heat exchangers shall be a closed-loop cycle, that is, one that recycles the cooling agent.

3.6.8 Prime Mover Exhaust Piping. Where applicable, the exhaust system shall include a muffler or silencer sized for the unit, and a flexible exhaust section.

3.6.9 Generators, Exciters, and Voltage Regulators. Generators shall comply with Article 445 of NFPA 70, *National Electrical Code,* and with the requirements of 3.6.9.1 through 3.6.9.9.

3.6.9.1 The generator shall be of dripproof construction and have amortisseur windings.

3.6.9.2 The generator shall be suitable for the environmental conditions at the installation location.

3.6.9.3 The generator systems shall be factory tested as a unit to ensure operational integrity of all of the following:

(1) Generator
(2) Exciter
(3) Voltage regulator

3.6.9.4 EPSS voltage output at full load shall match the nominal voltage of the normal source at the transfer switch(es).

3.6.9.5 Exciters, where furnished, shall be of either the rotating or static type.

3.6.9.6 Voltage regulators shall be capable of responding to load changes to meet the system stability requirements of 3.6.9.8.

3.6.9.7 If the system stability requirements of 3.6.9.8 can not be accomplished, anti-hunt provisions shall be included.

3.5.9.8 Generator system performance (i.e., prime mover, generator, exciter, and voltage regulator, as applicable when prototype tested as specified in 3.2.1.2) shall be as follows:

(a) Stable voltage and frequency at all loads shall be provided to full-rated loads.
(b) Values consistent with the user's needs for frequency droop and voltage droop shall be maintained.
(c) Voltage dip at the generator terminals for the maximum anticipated load change shall not cause disruption or relay dropout in the load.
(d) Frequency dip and restoration to steady state for any sudden load change shall not exceed the user's specified need.

3.5.9.9 The generator instrument panel for Level 1 applications shall contain the following:

(1) An ac voltmeter(s) for each phase or a phase selector switch
(2) An ac ammeter(s) for each phase or a phase selector switch
(3) A frequency meter
(4) A voltage-adjusting rheostat to allow +5 percent voltage adjustment

3.6.10 Miscellaneous Considerations.

3.6.10.1 Where applicable, the prime mover and generator shall be factory mounted on a common base rigid enough in order to maintain the dynamic alignment of the rotating element of the system prior to shipment to the installation site.

3.6.10.2 A certification shall be supplied with the unit that verifies the torsional vibration compatibility of the rotating element of the prime mover and generator for the intended use of the energy converter.

3.6.10.3* Vibration isolators shall be furnished where necessary to minimize vibration transmission to the permanent structure.

3.6.10.4 The manufacturer of the EPS shall submit complete schematic, wiring, and interconnection diagrams showing all terminal and destination markings for all EPS equipment, as well as the functional relationship between all electrical components.

3.6.10.5 The energy converter supplier shall stipulate compliance and performance with this standard for the entire unit when installed.

3.6.10.6 Where requested, the short circuit current capability at the generator output terminals shall be furnished.

Chapter 4 Transfer Switch Equipment

4.1 General.

4.1.1* Switches shall transfer electric loads from one power source to another.

4.1.2* The electrical rating shall be sized for the total load that is designed to be connected.

4.1.3 Each switch shall be in a separate enclosure or compartment.

4.1.4* The capacity of the switch, including all load current-carrying components, shall be rated to include all classes of loads to be served.

4.1.5 The switch, including all load current-carrying components, shall be designed to withstand the effects of available fault currents.

4.1.6* Where available, each switch shall be listed for emergency service as a completely factory-assembled and factory-tested apparatus.

4.2 Automatic Transfer Switch Features.

4.2.1* General. Automatic transfer switches shall be capable of all of the following:

(1) Electrical operation and mechanical holding
(2) Transfer and retransfer of the load automatically
(3) Visual annunciation when "not-in-automatic"

4.2.2 Source Monitoring.

4.2.2.1 Undervoltage-sensing devices shall be provided to monitor all ungrounded lines of the primary source of power as follows:

(a) When the voltage on any phase falls below the minimum operating voltage of any load to be served, the transfer switch shall automatically initiate engine start and the process of transfer to the emergency power supply (EPS).

(b)* When the voltage on all phases of the primary source returns to within specified limits for a designated period of time, the process of transfer back to primary power shall be initiated.

4.2.2.2 Both voltage-sensing and frequency-sensing equipment shall be provided to monitor one ungrounded line of the EPS power.

4.2.2.3 Transfer to the EPS shall be inhibited until the voltage and frequency are within a specified range to handle loads to be served.

(a) Sensing equipment shall not be required in the transfer switch, provided it is included with the engine control panel.

(b) Frequency-sensing equipment shall not be required for monitoring the public utility source where used as an EPS, as permitted by 3.1.5.

4.2.3 Interlocking. Mechanical interlocking or an approved alternate method shall prevent the inadvertent interconnection of the primary power supply and the EPS, or any two separate sources of power.

4.2.4* Manual Operation. Instruction and equipment shall be provided for safe manual nonelectric transfer in the event the transfer switch malfunctions.

4.2.5* Time Delay on Starting of EPS. A time-delay device shall be provided to delay starting of the EPS. The timer shall prevent nuisance starting of the EPS and possible subsequent load transfer in the event of harmless momentary power dips and interruptions of the primary source.

4.2.6 Time Delay at Engine Control Panel. Time delays shall be permitted to be located at the engine control panel in lieu of in the transfer switches.

4.2.7 Time Delay on Transfer to EPS. An adjustable time-delay device shall be provided to delay transfer and sequence load transfer to the EPS to avoid excessive voltage drop when the transfer switch is installed for Level 1 use.

4.2.7.1 Time Delay Commencement. The time delay shall commence when proper EPS voltage and frequency are achieved.

4.2.7.2 Time Delay at Engine Control Panel. Time delays shall be permitted to be located at the engine control panel in lieu of in the transfer switches.

4.2.8* Time Delay on Retransfer to Primary Source. An adjustable time-delay device with automatic bypass shall be provided to delay retransfer from the EPS to the primary source of power, and allow the primary source to stabilize before retransfer of the load.

4.2.9 Time Delay Bypass If EPS Fails. The time delay shall be automatically bypassed if the EPS fails.

4.2.9.1 The transfer switch shall be permitted to be programmed for a manually initiated retransfer to the primary source to provide for a planned momentary interruption of the load.

4.2.9.2 If used, the arrangement in 4.2.9.1 shall be provided with a bypass feature to allow automatic retransfer in the event that the EPS fails and the primary source is available.

4.2.10 Time Delay on Engine Shutdown. A minimum time delay of 5 minutes shall be provided for unloaded running of the EPS prior to shutdown to allow for engine cooldown.

4.2.10.1 The minimum 5-minute delay shall not be required on small (15 kW or less) air-cooled prime movers.

4.2.10.2 A time-delay device shall not be required, provided it is included with the engine control panel, or if a utility feeder is used as an EPS.

4.2.11* Engine Generator Exercising Timer. A program timing device shall be provided to exercise the EPS as described in Chapter 6.

4.2.11.1 Transfer switches for Level 1 and Level 2 shall transfer the connected load to the EPS and immediately return to primary power automatically in case of the EPS failure.

4.2.11.2 Exercising timers shall be permitted to be located at the engine control panel in lieu of in the transfer switches.

4.2.11.3 A program timing device shall not be required in health care facilities that provide scheduled testing in accordance with NFPA 99, *Standard for Health Care Facilities*.

4.2.12 Test Switch. A test shall be provided on each automatic transfer switch (ATS) that simulates failure of the primary power source and their transfers the load to the EPS.

4.2.13* Indication of Switch Position. Two pilot lights with identification nameplates or other approved position indicators shall be provided to indicate the transfer switch position.

4.2.14* Motor Load Transfer. Provisions shall be included to reduce currents resulting from motor load transfer if such currents could damage emergency power supply system (EPSS) equipment or cause nuisance tripping of EPSS overcurrent protective devices.

4.2.15* Isolation of Neutral Conductors. Provisions shall be included for ensuring continuity, transfer, and isolation of the primary and the EPS neutral conductors wherever they are separately grounded to achieve ground-fault sensing.

4.2.16* Nonautomatic Transfer Switch Features. Switching devices shall be mechanically held and shall be operated by direct manual or electrical remote manual control.

4.2.16.1 Interlocking. Reliable mechanical interlocking, or an approved alternate method, shall prevent the inadvertent interconnection of the primary power source and the EPS.

4.2.16.2 Indication of Switch Position. Two pilot lights with identification nameplates, or other approved position indicators, shall be provided to indicate the switch position.

4.3 Load Switching (Load Shedding). When two or more engine generator sets are paralleled for emergency power, the paralleled system shall be arranged to inhibit connection of EPS-damaging loads.

4.3.1 Each transfer switch shall have a continuous current rating and interrupting rating for all classes of loads to be served.

4.3.2 The transfer switch shall be capable of withstanding the available fault current at the point of installation.

4.3.3 The transfer of loads to the EPS shall be sequenced as follows:

(1) First priority loads shall be switched to the emergency bus upon sensing the availability of emergency power on the bus.
(2) Each time an additional engine generator set is connected to the bus, a remaining load shall be connected in order of priority until all emergency loads are connected to the bus.
(3) The system shall be designed so that, upon failure of one or more engine generator sets, the load is automatically reduced, starting with the load of least priority and proceeding in ascending priority, so that the last load affected is the highest priority load.

4.4 Bypass-Isolation Switches.

4.4.1 Bypassing and Isolating Transfer Switches. Bypass-isolation switches shall be permitted for bypassing and isolating the transfer switch, and installed in accordance with 4.4.2, 4.4.3, and 4.4.4.

4.4.2 Bypass-Isolation Switch Rating. The bypass-isolation switch shall have a continuous current rating, and current rating compatible with that of the associated transfer switch.

4.4.3* Bypass-Isolation Switch Classification. Each bypass-isolation switch shall be listed for emergency electrical service as a completely factory-assembled and factory-tested apparatus.

4.4.4* Operation. With the transfer switch isolated or disconnected, the bypass-isolation switch shall be designed so it can function as an independent nonautomatic transfer switch and allow the load to be connected to either power source.

4.4.5 Reconnection of Transfer Switch. Reconnection of the transfer switch shall be possible without a load interruption greater than the maximum time, in seconds, specified by the type of system.

4.5 Protection.

4.5.1* General. The overcurrent protective devices in the EPSS shall be coordinated to optimize selective tripping of the circuit overcurrent protective devices when a short circuit occurs.

4.5.2 Short Circuit Current. The maximum available short circuit current from both the utility source and the emergency energy source shall be evaluated for ability to satisfy this coordination capability.

4.5.3* Overcurrent Protective Device Rating. The overcurrent protective device shall have an interrupting rating equal to or greater than the maximum available short circuit current at its location.

4.5.4 Accessibility. Overcurrent devices in EPSS circuits shall be accessible to authorized persons only.

Chapter 5 Installation and Environmental Considerations

5.1 General.

5.1.1* This chapter shall establish minimum requirements and considerations relative to the installation and environmental conditions that have an effect on the performance of the emergency power supply system (EPSS) equipment such as the following:

(1) Geographic location
(2) Building type
(3) Classification of occupancy
(4) Hazard of contents

5.1.2* Minimizing the probability of equipment or cable failure within the EPSS shall be a design consideration to reduce the disruption of loads served by the EPSS.

5.1.3 The EPSS equipment shall be installed as required to meet the user's needs and to be in accordance with all of the following:

(1) This standard
(2) The manufacturer's specifications
(3) The authority having jurisdiction

5.1.4 EPSS equipment installed for the various levels of service defined in this standard shall be designed and assembled for such service.

5.1.5 When the normal power source is not available, the EPS shall be permitted to serve optional loads other than Level 1 and Level 2 system loads, provided that the EPS has the capacity, or that automatic selective load pickup and shedding is provided as needed to ensure power to the Level 1 loads, Level 2 loads, and the optional loads in that order of priority.

5.1.6 When normal power is available, the EPS shall be permitted to be used for other purposes such as any of the following:

(1) Peak load shaving
(2) Internal voltage control
(3) Load relief for the utility providing normal power
(4) Cogeneration

5.1.7 When primary power is not available, the EPS shall serve Level 1 and Level 2 systems' loads and shall be permitted to serve additional loads, other than Level 1 and Level 2 systems' loads, under the following conditions:

(a) Multiple energy converters are installed.
(b) Upon failure of any one energy converter, loads, other than Level 1 and Level 2 systems' loads, shall be automatically shed when required so that the remaining energy converter(s) has the required capacity to serve the Level 1 and Level 2 systems' loads.

5.2 Location.

5.2.1 The EPS shall be installed in a separate room for Level 1 installations. EPSS equipment shall be permitted to be installed in this room.

5.2.1.1 The room shall have a minimum 2-hour fire rating or be located in an adequate enclosure located outside the building capable of resisting the entrance of snow or rain at a maximum wind velocity required by local building codes.

5.2.1.2 No other equipment, including architectural appurtenances, except those that serve this space, shall be permitted in this room.

5.2.2 EPSS equipment shall not be installed in the same room where the normal electrical service equipment is installed.

5.2.2.1 Transfer switches shall be permitted to be installed in the normal electrical service room where twice the clearance required by Article 110.16(a) of NFPA 70, *National Electrical Code*, exists between equipment enclosures.

5.2.3* The rooms, shelters, or separate buildings housing Level 1 or Level 2 EPSS equipment shall be designed and located to minimize the damage from flooding, including that caused by the following:

(1) Flooding resulting from fire fighting
(2) Sewer water backup
(3) Similar disasters or occurrences

5.2.4* Minimizing the possibility of damage resulting from interruptions of the emergency source shall be a design consideration for Level 1 and Level 2 EPSS equipment.

5.2.5 The EPS equipment shall be installed in a location that permits ready accessibility and a minimum of 76 cm (36 in.) clearance from the prime movers valve covers in the direction of access for any of the following:

(1) Inspection
(2) Repair
(3) Maintenance
(4) Cleaning
(5) Replacement

5.2.6 Design considerations shall minimize the effect of the failure of one energy converter on the continued operation of other units.

5.3 Lighting.

5.3.1 The Level 1 or Level 2 EPS equipment location(s) shall be provided with battery-powered emergency lighting. This requirement shall not apply to units located outdoors in enclosures that do not include walk-in access.

5.3.2 The emergency lighting charging system and the normal service room lighting shall be supplied from the load side of the transfer switch.

5.3.3* The intensity of illumination in the separate building or room housing the EPS equipment for Level 1 shall be 32.3 lux (30 ft-candles), unless otherwise specified by a requirement recognized by the authority having jurisdiction.

5.4 Mounting.

5.4.1 Rotating energy converters shall be installed on solid foundations to prohibit sagging of fuel, exhaust, or lubricating-oil piping and damage to parts resulting in leakage at joints.

5.4.1.1 Such foundations or structural bases shall raise the engine at least 150 mm (6 in.) above the floor or grade level and be of sufficient elevation to facilitate lubricating-oil drainage and ease of maintenance.

5.4.2 Foundations shall be of the size (mass) and type recommended by the energy converter manufacturer.

5.4.3 Where required to prevent transmission of vibration during operation, the foundation shall be isolated from the surrounding floor or other foundations, or both, in accordance with the manufacturer's recommendations and accepted structural engineering practices.

5.4.4 The EPS shall be mounted on a fabricated metal skid base of the type that shall resist damage during shipping and handling. After installation, the base shall maintain alignment of the unit during operation.

5.5* Vibration. Vibration isolators, as recommended by the manufacturer of the EPS, shall be installed either between the rotating equipment and its skid base or the skid base and the foundation or inertia base.

5.6* Noise. Design shall include consideration of noise control regulations.

5.7 Heating, Cooling, and Ventilating.

5.7.1* With the EPS running at rated load ventilation air shall be provided to limit the maximum air temperature in the EPS room to the maximum ambient air temperature required by the EPS manufacturer.

5.7.2 The ventilation or air-conditioning systems shall be properly sized to remove the heat rejected to the EPS equipment room by all of the following:

(1) The energy converter
(2) Uninsulated or insulated exhaust pipes
(3) Other heat-producing equipment

5.7.3 Ventilation air supply shall be from outdoors or from a source outside of the building by an exterior wall opening or from a source outside the building using a 2-hour fire-rated air transfer system.

5.7.4 Ventilation air shall be provided to supply and discharge cooling air for radiator cooling of the EPS to run at rated load.

5.7.4.1 Ventilation air supply and discharge for radiator-cooled EPS shall have a maximum static restriction of 125 Pa (0.5 in. of water column) in the discharge duct at the radiator outlet.

5.7.4.2 Radiator air discharge shall be ducted outdoors and away from building openings or to an exterior opening by a 2-hour fire-rated air transfer system.

5.7.4.3 Fire dampers, shutters, or other self-closing devices shall not be permitted in ventilation openings or ductwork for supply or return/discharge air to EPS equipment for a Level 1 EPSS.

5.7.4.4 Motor-operated dampers, when used, shall be spring-operated to open and motor-closed.

5.7.5 Provision shall be made to maintain the ambient air temperature in the EPS equipment room or outdoor housing containing Level 1 rotating equipment at a temperature not less than 4.5°C (40°F).

5.7.6 Units housed outdoors shall be heated as specified in 3.3.3.

5.7.7 Design of the heating, cooling, and ventilation system for the EPS equipment room shall include provision for factors including, but not limited to, the following:

(1) Heat
(2) Cold
(3) Dust
(4) Humidity
(5) Snow and ice accumulations around housings
(6) Louvers
(7) Remote radiator fans
(8) Prevailing winds blowing against radiator fan discharge air

5.8 Installed EPS Cooling System.

5.8.1 The installed EPS cooling system shall be designed to cool the prime mover at full rated load while operating in the particular installation circumstances of each EPS.

5.8.1.1 A full load on-site test shall not result in activation of high-temperature prealarm or high-temperature shutdown.

5.8.2* For EPSS cooling systems requiring intermittent or continuous waterflow, pressure, or both, a utility, city, or other water supply service shall not be used.

5.8.2.1 The EPSS cooling system shall be permitted to use utility or city water for filling or makeup water.

5.8.3 Makeup water hose bibs and floor drains, where required by other codes and standards, shall be installed in EPS equipment rooms.

5.8.4 Where duct connections are used between the prime mover radiator and air-out louvers, the ducts shall be connected to the prime movers by means of flexible sections.

5.8.5 Design of the EPS cooling system shall consider the following factors:

(1) Remote radiator or heat exchanger sizing
(2) Pipe sizing
(3) Pump sizing
(4) Sufficient shutoffs to isolate equipment to facilitate maintenance
(5) The need for and sizing of de-aeration and surge tanks
(6) Drain valves for cleaning and flushing the cooling system
(7) Type of flexible hoses between the prime mover and the cooling system piping

5.9 Fuel System.

5.9.1 Fuel tanks shall be sized to accommodate the specific EPS class.

5.9.1.1 All fuel tanks and systems shall be installed and maintained in accordance with NFPA 30, *Flammable and Combustible Liquids Code*, NFPA 37, *Standard for the Isntallation and Use of Stationary Combustion Engines and Gas Turbines*, NFPA 45, *Standard on Fire Protection for Laboratories*, and NFPA 58, *Liquefied Petroleum Gas Code*.

5.9.1.2 Fuel system design shall provide a supply of clean fuel to the prime mover.

5.9.1.3* Tanks shall be sized so that the fuel is consumed within the storage life, or provision shall be made to replace stale fuel with clean fuel.

5.9.2 Fuel tanks shall be placed as close as practicable to the prime mover. The fuel lift (suction head) of the prime mover fuel pump shall be sized to meet the fuel system requirements, or a fuel transfer pump and day tank shall be utilized.

5.9.2.1 If the engine manufacturer's fuel pump static head pressure limits are exceeded when the level of fuel in the tank is at a maximum, a day tank shall be utilized.

5.9.3 Fuel piping shall be of compatible metal to minimize electrolysis and shall be properly sized, with vent and fill pipes located to prevent entry of groundwater or rain into the tank.

5.9.3.1 Galvanized fuel lines shall not be used.

5.9.3.2 Approved flexible fuel lines shall be used between the prime mover and the fuel piping.

5.9.4 Day tanks on diesel systems shall be installed below the engine fuel return elevation.

5.9.4.1 The return line to the day tank shall be below the fuel return elevation.

5.9.4.2 Gravity fuel oil return lines between the day tank and the main supply tank shall be sized to handle the potential fuel flow and shall be free of traps so that fuel can flow freely to the main tank.

5.9.5 Integral tanks of the following capacities shall be permitted inside or on roofs of structures, or as approved by the authority having jurisdiction:

(1) Maximum of 2498 L (660 gal) diesel fuel
(2) Maximum of 95 L (25 gal) gasoline fuel

5.9.6 Quantities of all types of fuels stored in buildings shall meet the approval of the authority having jurisdiction.

5.9.7* The fuel supply for gas-fueled and liquid-fueled prime movers shall be installed in accordance with applicable standards.

5.9.8* The fuel supply to gas-fueled prime movers shall be connected ahead of the building's main shutoff valve and marked as supplying an emergency generator.

5.9.9 The building's main gas shutoff valve shall be marked or tagged to indicate the existence of the separate EPS shutoff valve.

5.9.10 The fuel supply for gas-fueled and liquid-fueled prime movers shall be designed to meet the demands of the prime mover for all of the following factors:

(1) Sizing of fuel lines
(2) Valves including manual shutoff
(3) Battery-powered fuel solenoids
(4) Gas regulators
(5) Regulator vent piping
(6) Flexible fuel line section
(7) Fuel line filters
(8) Fuel vaporizers (LP-Gas)
(9) Ambient temperature effect of fuel tank vaporization rates of LP-Gas where applicable

5.9.11 The fuel storage and supply lines for an EPSS shall be in accordance with this standard or with the specific authority having jurisdiction, or both.

5.9.12 All manual fuel system valves shall be of the indicating type.

5.9.13 Listed generator sub-base secondary containment fuel tanks of 2498 L (660 gal) capacity and below shall be permitted to be installed outdoors or indoors without diking or remote impounding.

5.9.1.3.1 A minimum clearance of 0.9 m (3 ft) shall be maintained on all sides.

5.10 Exhaust System.

5.10.1* The exhaust system equipment and installation, including piping, muffler, and related accessories, shall be in accordance with applicable standards.

5.10.2 Exhaust system installation shall be gastight to prevent exhaust gas fumes from entering inhabited rooms or buildings and terminate in such a manner that toxic fumes cannot reenter a building or structure, particularly through windows, air ventilation inlets, or the engine air-intake system.

5.10.3* Exhaust piping shall be connected to the prime mover by means of a flexible connector and shall be independently supported thereafter so that no damaging weight or stress is applied to the engine exhaust manifold or turbocharger.

5.10.3.1 A condensate trap and drain valve shall be provided at the low point of the piping.

5.10.3.2 Design consideration shall be given to thermal expansion and the resultant movement of the piping.

5.10.3.3 For reciprocating engines, mufflers shall be placed as close as practicable to the engine, in a horizontal position if possible.

5.10.3.4 An approved thimble(s) shall be used where exhaust piping passes through combustible walls or partitions.

5.10.3.5 For reciprocating engines, the piping shall terminate in any of the following:

(1) Rain cap
(2) Tee
(3) Ell, pointing downwind from the prevailing wind

5.10.3.6 Design consideration shall be given to the potential heat effect due to proximity to all of the following:

(1) Conduit runs
(2) Fuel piping
(3) Lighting fixtures

5.10.3.7 Design consideration shall be given to insulating the engine exhaust systems in buildings after the flexible section.

5.10.4 For maximum efficiency, operation economy, and prevention of engine damage, the exhaust system shall be designed to eliminate excessive backpressure on the engine by properly selecting, routing, and installing the following: the piping size, connections, and muffler.

5.10.4.1 Exhaust systems shall be installed to ensure satisfactory EPS operation and meet the requirements of the manufacturer.

5.10.5 Exhaust system requirements shall be in accordance with NFPA 37, *Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines.*

5.11 Protection.

5.11.1 The room in which the EPS equipment is located shall not be used for storage purposes.

5.11.2* Where fire suppression systems are installed in EPS equipment rooms or separate buildings, the following systems shall not be used:

(1) Carbon dioxide or halon systems, unless prime mover combustion air is taken from outside the structure
(2) An automatic dry chemical system, unless the manufacturers of the EPS certify that the dry chemical system cannot damage the EPS system, hinder its operation, or reduce its output

5.11.3* Where the EPS rooms or separate buildings are equipped with fire detection systems, the installation shall be in accordance with applicable standards.

5.11.4 The EPS equipment shall be protected from damage due to lightning in accordance with applicable standards.

5.11.5* In recognized seismic risk areas, EPS and EPSS components, such as electrical distribution lines, water distribution lines, fuel distribution lines, and other components that serve the EPS, shall be designed to minimize damage from earthquakes and to facilitate repairs if an earthquake occurs.

5.11.6* For Level 1 and Level 2 systems in seismic risk areas, the EPS, transfer switches, distribution panels, circuit breakers, and associated controls shall be capable of performing their intended function during and after being subjected to the anticipated seismic shock.

5.12 Distribution.

5.12.1* The distribution and wiring systems within EPSSs shall be installed in accordance with applicable standards.

5.12.2* Where applicable, in addition to the requirements of 5.12.1, distribution and wiring systems of Level 1 EPSSs shall be installed in accordance with applicable standards.

5.12.3 The wiring between the EPS output terminals and the first distribution overcurrent protective device terminals within the EPSS shall be located at a minimal distance to ensure system reliability and safety.

5.12.4 If the conduit's point of attachment to the EPS is on the forcing function side of the EPS vibration isolation system, a flexible conduit section(s) shall be installed between the EPS unit(s) and any of the following, so attached:

(a) The transfer switch
(b) The control and annunciator wiring
(c) Any accessory supply wiring such as jacket water heaters

5.12.4.1 Stranded wire shall be used of an adequate size to minimize of adequate size shall be used to minimize breakage due to vibration.

5.12.4.2 Bushings shall be installed to protect wiring from abrasion with conduit terminations.

5.12.5 All ac-powered support and accessory equipment necessary to the operation of the EPS shall be supplied from the load side of the automatic transfer switch(es), or the output terminals of the EPS, ahead of the main EPS overcurrent protection to ensure continuity of the EPSS operation and performance.

5.12.6 The starting battery units shall be located next to the prime mover starter to minimize voltage drop.

5.12.6.1 Battery cables shall be sized to minimize voltage drop in accordance with the manufacturer's recommendations and accepted engineering practices.

5.12.6.2 Battery charger output wiring shall be permanently connected.

5.12.6.3 Connections shall not be made at the battery terminals.

5.13 Installation Acceptance.

5.13.1 Upon completion of the installation of the EPSS, the EPS shall be tested to ensure conformity to the requirements of the standard with respect to both power output and function.

5.13.2 An on-site acceptance test shall be conducted as a final approval test for all EPSSs.

5.13.2.1 For new Level 1 installations, the EPSS shall not be considered as meeting this standard until the acceptance tests have been conducted and test requirements met.

5.13.2.2 The test shall be conducted after completion of the installation with all EPSS accessory and support equipment in place and operating.

5.13.3 The authority having jurisdiction shall be given advance notification of the time at which the final test is to be performed so that the authority can witness the test.

5.13.4 The EPSS shall perform within the limits specified in this standard.

5.13.4.1* The on-site installation test shall be conducted in the following manner:

(a) With the prime mover in a "cold start" condition and the emergency load at standard operating level, a primary power failure shall be initiated by opening all switches or breakers supplying the primary power to the building or facility.
(b) The test load shall be that load that is served by the EPSS.
(c) The time delay on start shall be observed and recorded.
(d) The cranking time until the prime mover starts and runs shall be observed and recorded.
(e) The time taken to reach operating speed shall be observed and recorded.
(f) The voltage and frequency overshoot shall be recorded.
(g) The time taken to achieve a steady-state condition with all switches transferred to the emergency position shall be observed and recorded.
(h) The voltage, frequency, and amperes shall be recorded.
(i) The prime mover oil pressure and water temperature shall be recorded, where applicable.
(j) The battery charge rate shall be recorded at 5-minute intervals for the first 15 minutes, and at 15-minute intervals thereafter.
(k) The load test with building load, or other loads that simulate the intended load as specified in 3.4.3.4, shall be continued for the minimum time required by Table 2.2.1(a) for the class, or 2 hours maximum, observing and recording load changes and the resultant effect on voltage and frequency.
(l) When primary power is returned to the building or facility, the time delay on retransfer to primary for each switch with a minimum setting of 5 minutes shall be recorded.
(m) The time delay on the prime mover cooldown period and shutdown shall be recorded.

5.13.5 After completion of the test performed in 5.13.4.1, the prime mover shall be allowed to cool for 5 minutes.

5.13.6 A load shall be applied for a 2-hour, full load test. The building load shall be permitted to serve as part or all of the load, supplemented by a load bank of sufficient size to provide a load equal to 100 percent of the nameplate kW rating of the EPS, less applicable derating factors for site conditions.

5.13.6.1 A unity power factor shall be acceptable for on-site testing, provided that rated load tests at the rated power factor have been performed by the manufacturer of the EPS prior to shipment.

5.13.6.2 Where the EPS is a paralleled multi-unit EPS, each unit shall be permitted to be tested individually at its rating.

5.13.7 A full load test shall be initiated immediately after the cooling time specified in 5.13.5 by any method that starts the prime mover and, immediately upon reaching rated rpm, picks up 100 percent of the nameplate kW rating on one step, less applicable derating factors for site conditions.

5.13.7.1 Where the EPS is a paralleled multi-unit EPS, each unit shall be permitted to be tested individually at its rating.

5.13.8 The data specified in 5.13.4.1(d), (e), (f), (g), (h), (i) and (j) shall be recorded at first load acceptance and every 15 minutes thereafter until the completion of the 2-hour test period.

5.13.9 Any method recommended by the manufacturer for the cycle crank test shall be utilized to prevent the prime mover from running.

5.13.9.1 The control switch shall be set at "run" to cause the prime mover to crank.

5.13.9.2 The complete crank/rest cycle specified in 3.6.4.2 and Table 3.6.4.2 shall be observed.

5.13.10 All safeties specified in 3.6.5 and 3.6.6 shall be tested as recommended by the manufacturer.

5.13.11 The following shall be made available to the authority having jurisdiction at the time of the acceptance test:

(1) Evidence of the prototype test as specified in 3.2.1.2 (for Level 1 systems)
(2) A certified analysis as specified in 3.6.10.2
(3) A letter of compliance as specified in 3.6.10.5
(4) A manufacturer's certification of a rated load test at rated power factor with the ambient temperature, altitude, and fuel grade recorded

Chapter 6 Routine Maintenance and Operational Testing

6.1* General. The routine maintenance and operational testing program shall be based on all of the following:

(1) Manufacturer's recommendations
(2) Instruction manuals
(3) Minimum requirements of this chapter
(4) The authority having jurisdiction

6.2* Manuals, Special Tools, and Spare Parts.

6.2.1 At least two sets of instruction manuals for all major components of the EPSS shall be supplied by the manufacturer(s) of the EPSS and shall contain the following:

(1) A detailed explanation of the operation of the system
(2) Instructions for routine maintenance
(3) Detailed instructions for repair of the EPS and other major components of the EPSS
(4) An illustrated parts list and part numbers
(5) Illustrated and schematic drawings of electrical wiring systems, including operating and safety devices, control panels, instrumentation, and annunciators

6.2.2 For Level 1 systems, instruction manuals shall be kept in a secure, convenient location, one set near the equipment, and the other set in a separate location.

6.2.3 Special tools and testing devices necessary for routine maintenance shall be available for use when needed.

6.2.4 Replacement for parts identified by experience as high mortality items shall be maintained in a secure location(s) on the premises.

6.2.4.1 Consideration shall be given to stocking spare parts as recommended by the manufacturer.

6.3 Maintenance and Operational Testing.

6.3.1* The EPSS shall be maintained to ensure to a reasonable degree that the system is capable of supplying service within the time specified for the type and for the time duration specified for the class.

6.3.2 A routine maintenance and operational testing program shall be initiated immediately after the EPSS has passed acceptance tests or after completion of repairs that impact the operational reliability of the system.

6.3.3 A written schedule for routine maintenance and operational testing of the EPSS shall be established.

6.3.4 A written record of the EPSS inspections, tests, exercising, operation, and repairs shall be maintained on the premises.

6.3.4.1 The written record shall include the following:

(1) The date of the maintenance report
(2) Identification of the servicing personnel
(3) Notation of any unsatisfactory condition and the corrective action taken, including parts replaced
(4) Testing of any repair for the time as recommended by the manufacturer

6.3.5* Transfer switches shall be subjected to a maintenance program that includes all of the following oeprations:

(1) Checking of connections
(2) Inspection or testing for evidence of overheating and excessive contact erosion
(3) Removal of dust and dirt
(4) Replacement of contacts when required

6.3.6* Storage batteries, including electrolyte levels, used in connection with Level 1 and Level 2 systems shall be inspected weekly and maintained in full compliance with manufacturer's specifications.

6.3.6.1 Maintenance of lead-acid batteries shall include the monthly checking and recording of electrolyte specific gravity.

6.3.6.2 Defective batteries shall be replaced immediately upon discovery of defects.

6.4 Operational Inspection and Testing.

6.4.1* Level 1 and Level 2 EPSSs, including all appurtenant components, shall be inspected weekly and exercised under load at least monthly.

6.4.1.1 If the generator set is used for standby power or for peak load shaving, such use shall be recorded and shall be permitted to be substituted for scheduled operations and testing of the generator set, providing the same record as required by 6.3.4.

6.4.2* Generator sets in Level 1 and Level 2 service shall be exercised at least once monthly, for a minimum of 30 minutes, using one of the following methods:

(1) Under operating temperature conditions or at not less than 30 percent of the EPS nameplate rating
(2) Loading that maintains the minimum exhaust gas temperatures as recommended by the manufacturer

6.4.2.1 The date and time of day for required testing shall be decided by the owner, based on facility operations.

6.4.2.2 Equivalent loads used for testing shall be automatically replaced with the emergency loads in case of failure of the primary source.

6.4.2.3 Diesel-powered EPS installations that do not meet the requirements of 6.4.2 shall be exercised monthly with the available EPSS load and exercised annually with supplemental loads at 25 percent of nameplate rating for 30 minutes, followed by 50 percent of nameplate rating for 30 minutes, followed by 75 percent of nameplate rating for 60 minutes, for a total of 2 continuous hours.

6.4.3 Load tests of generator sets shall include complete cold starts.

6.4.4 Time delays shall be set as follows:

(1) Time delay on start: 1 second minimum for diesel powered units and 0.5 second minimum for gas turbine units
(2) Time delay on transfer to emergency: no minimum required
(3) Time delay on restoration to normal: 5 minutes minimum
(4) Time delay on shutdown: 5 minutes minimum

6.4.5 Level 1 and Level 2 transfer switches shall be operated monthly.

6.4.5.1 The monthly test of a transfer switch shall consist of electrically operating the transfer switch from the standard position to the alternate position and then a return to the standard position.

6.4.6* EPSS circuit breakers for Level 1 system usage, including main and feed breakers between the EPS and the transfer switch load terminals, shall be exercised annually with the EPS in the "off" position.

6.4.6.1 Medium- and high-voltage circuit breakers for Level 1 system usage shall be exercised every 6 months and shall be tested under simulated overload conditions every 2 years.

6.4.7 The routine maintenance and operational testing program shall be overseen by a properly instructed individual.

Chapter 7 Referenced Publications

7.1 The following documents or portions thereof are referenced within this standard as mandatory requirements and shall be considered part of the requirements of this standard. The edition indicated for each referenced mandatory document is the current edition as of the date of the NFPA issuance of this standard. Some of these mandatory documents might also be referenced in this standard for specific informational purposes and, therefore, are also listed in Annex C.

7.1.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 30, *Flammable and Combustible Liquids Code*, 2000 edition.
NFPA 37, *Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines*, 1998 edition.
NFPA 45, *Standard on Fire Protection for Laboratories Using Chemicals*, 2000 edition.
NFPA 58, *Liquefied Petroleum Gas Code*, 2001 edition.
NFPA 70, *National Electrical Code®*, 1999 edition.
NFPA 99, *Standard for Health Care Facilities*, 1999 edition.

Annex A Explanatory Material

Annex A is not a part of the requirements of this NFPA document but is included for informational purposes only. This Annex contains explanatory material, numbered to correspond with the applicable text paragraphs.

A.1.1.4 See NFPA 111, *Standard on Stored Electrical Energy Emergency and Standby Power Systems.*

A.1.1.5(3) See Section 2.2.

A.2.1.1 Approved. The National Fire Protection Association does not approve, inspect, or certify any installations, procedures, equipment, or materials; nor does it approve or evaluate testing laboratories. In determining the acceptability of installations, procedures, equipment, or materials, the authority having jurisdiction may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure, or use. The authority having jurisdiction may also refer to the listings or labeling practices of an organization that is concerned with product evaluations and is thus in a position to determine compliance with appropriate standards for the current production of listed items.

A.2.1.2 Authority Having Jurisdiction. The phrase "authority having jurisdiction" is used in NFPA documents in a broad manner, since jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiction may be a federal, state, local, or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the authority having jurisdiction. In many circumstances, the property owner or his or her designated agent assumes the role of the authority having jurisdiction; at government installations, the commanding officer or departmental official may be the authority having jurisdiction.

A.2.1.3 Battery Certification. One such certifier of batteries is the American Association of Battery Manufacturers.

A.2.1.4 Emergency Power Supply (EPS). For rotary energy converters, components of an EPS include the following:

(1) Prime mover
(2) Cooling system
(3) Generator
(4) Excitation system
(5) Starting system
(6) Control system
(7) Fuel system
(8) Lube system, if required

A.2.1.5 Emergency Power Supply System (EPSS). See Annex B for diagrams of typical systems.

A.2.1.8 Listed. The means for identifying listed equipment may vary for each organization concerned with product evaluation; some organizations do not recognize equipment as listed unless it is also labeled. The authority having jurisdiction should utilize the system employed by the listing organization to identify a listed product.

A.2.2.1 This standard specifies requirements for the EPSS as a complete functioning system in terms of types, classes, and levels. It is not the intent of this standard to recommend the EPSS most suitable for any given application. The terms *emergency power supply systems* and *standby power supply systems* as used in this standard include, but are not limited to, such terms as the following:

(1) *Alternate power systems*
(2) *Standby power systems*
(3) *Legally required standby systems*
(4) *Alternate power sources*

Since this standard specifies the installation, performance, maintenance, and test requirements in terms of types, classes, and levels, any of these terms might be appropriate for describing the application or use, depending on the need and the preference of the parties involved.

A.2.2.3 Selection of the class of the EPSS should take into account past outage records and fuel delivery problems due to weather, shortages, and other geographic/environmental conditions.

A.2.2.4 It is recognized that EPSSs are utilized in many different locations and for many different purposes. The requirement for one application might not be appropriate for other applications.

A.2.2.4.1 Typically, Level 1 systems are intended to automatically supply illumination or power, or both, to critical areas and equipment in the event of failure of the primary supply or in the event of danger to elements of a system intended to supply, distribute, and control power and illumination essential for safety to human life.

Level 1 systems generally are installed in places of assembly where artificial illumination is required by other standards for safe exiting and for panic control in buildings subject to occupancy by large numbers of people.

Emergency systems can also provide power for such functions as ventilation when essential to maintain the following, as well as other similar functions:

(1) Life
(2) Fire detection and alarm systems
(3) Elevators
(4) Fire pumps
(5) Public safety communications systems
(6) Industrial processes where current interruption would produce serious life safety or health hazards

See NFPA *101®*, *Life Safety Code®*, and Chapter 3, Electrical Systems, of NFPA 99, *Standard for Health Care Facilities*.

A.2.2.4.2 Typically, Level 2 systems are intended to supply power automatically to selected loads (other than those classed as emergency systems) in the event of failure of the primary source.

Level 2 systems typically are installed to serve loads such as the following, that, when stopped due to any interruption of the primary electrical supply, could create hazards or hamper rescue or fire-fighting operations:

(1) Heating and refrigeration systems
(2) Communications systems
(3) Ventilation and smoke removal systems
(4) Sewerage disposal
(5) Lighting
(6) Industrial processes

A.2.2.4.4 It is important to recognize that an EPSS might react substantially different from commercial power during transient and short circuit conditions due to the relatively small capacities of the EPSS as compared to the primary commercial power source. (See ANSI C84.1, *Standard for Electric Power Systems and Equipment Voltage Ratings*.)

A.3.1.1(1) See A.3.5.3 for shelf-life precautions for fuel supplies.

A.3.1.3 The seismic risk areas that should be addressed specifically are those designated as Zones 3 and 4 of the Uniform Building Code, as modified by the authorities having jurisdiction.

A.3.1.5 On-site energy conversion is not restricted to rotating-type generating systems. Other types of continuous energy conversion systems can be used, including fuel-cell systems.

A.3.2.2 The following devices are typical of energy converters and energy sources that should be reviewed carefully as part of Level 1 EPSs:

(1) Motor-generator/engine
(2) Motor-generator/flywheel
(3) Steam turbine

Connection to the primary power source ahead of the primary source main service disconnect and a separate service should be excluded as a sole source of EPS.

A.3.4 It is recognized that in some installations part or all of the output of the EPS might be used for peak shaving or that part of the output might be used for driving nonessential loads during loss of the primary power source. Load-shedding of these loads when the output of the energy converter is needed is one way of meeting the requirements of 3.4.

The load should be reviewed to ascertain that load growth has not exceeded EPS capability.

A.3.5.2 The low-fuel alarm point for liquid-fueled engines is defined as the point when the main fuel tank contains insufficient fuel to meet the required full load operating hours and is the point at which this condition is signaled.

A.3.5.3 Consideration should be given to sizing tanks in order to meet minimum fuel supplier delivery requirements, particularly for small tanks. Consideration also should be given to oversizing tanks, because many fuels have a shelf life and deteriorate with age. Where large tanks are required, it is recommended that fuels be periodically pumped out and used in other services and replaced with fresh fuel.

Prudent disaster management could require much larger on-site temporary or permanent fuel storage.

A.3.6.4.2 See Figure A.3.6.4.2 for a diagram of cranking cycles.

Existing A-3-5.4 (no change)
Figure A.3.6.4.2 Diagram of cranking cycles.

A.3.6.4.3 A battery unit is one or more batteries or a group of cells, a series, or a parallel series connected to provide the required battery unit voltage and capacity.

A.3.6.4.4 Cold-cranking amperes, or cranking performance, are the number of amperes a fully charged battery at -17.8°C (0°F) can continuously deliver for 30 seconds while maintaining 1.2 V per cell.

A.3.6.4.5.1 It is recommended that lead-acid starting batteries be replaced every 24 to 30 months.

A.3.6.9.1 See ANSI/NEMA MG1, *Standard for Motors and Generators*, and ANSI/NEMA MG2, *Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators.*

A.3.6.4.6 It is intended that the battery charger be factory-built, adjusted, and approved for the specific type, construction, and capacity of the battery. For lead-acid batteries, the battery charger should be tested for the specific gravity, type, and concentration of grid alloys, such as high or low gravity, high or low antimony, calcium, or none.

A.3.6.10.3 Where unusual vibration conditions are anticipated, adequate isolation treatment should be supplied.

A.4.1.1 Electrical switching is electrical equipment or devices used to do any or all of the following:

(1) Transfer connected electrical loads from one power source to another
(2) Perform load-switching functions
(3) Bypass, isolate, and test the transfer switch

A.4.1.2 Electrical protection equipment is sensing and overcurrent protective devices used to protect against damage due to fault or overload to conductors and equipment connected to the output of the emergency energy source, up to and including the load terminals of the transfer switch(es).

A.4.1.4 See ANSI/UL 1008*, Standard for Safety Transfer Switch Equipment.*

A.4.1.6 See Section 700-6 of NFPA 70, *National Electrical Code®*, and Section 7.8 of NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection*, for listing and installation requirements for transfer switches used with fire pumps.

A.4.2.1 For most applications in this standard, the automatic transfer switch is used to transfer a load from a primary source of supply to an engine generator set.

An automatic transfer switch might include circuit breakers, contactors, switches, or vacuum and solid-state power devices operating in conjunction with automatic-sensing and logic devices to perform the defined function.

A.4.2.2.1 Where special loads require more rapid detection of power loss, underfrequency monitoring also might be provided. Upon frequency decay below the lower limit necessary for proper operation of the loads, the transfer switch should automatically initiate transfer to the alternate source. (See A.4.2.14.)

A.4.2.2.1(b) See 4.2.5 and 4.2.7.

A.4.2.4 Authorized personnel should be available and familiar with manual operation of the transfer switch and should be capable of determining the adequacy of the alternate source of power prior to manual transfer.

A.4.2.5 For most applications, a nominal delay of 1 second is adequate. The time delay should be short enough so that the generator can start and be on the line within the time specified for the type classification.

A.4.2.8 It is recommended that the timer for delay on retransfer to the primary source be set for 30 minutes. The 30-minute recommendation is to establish a "normalized" engine temperature, when it is beneficial for the engine. NFPA 70, *National Electrical Code*, establishes a minimum time requirement of 15 minutes.

A.4.2.11 The timer might run the generator only, might run the generator and transfer the load to emergency power, or might be provided with a switch for optional operation.

A.4.2.13 For maintenance purposes, consideration should be given to a transfer switch counter.

A.4.2.15 Automatic transfer switches (ATS) can be provided with accessory controls that provide a signal to operate remote motor controls that disconnect motors prior to transfer, and to reconnect them after transfer when the residual voltage has been substantially reduced. Another method is to provide in-phase monitors within the ATS in order to prevent retransfer to the primary source until both sources are nearly synchronized. A third method is to use a programmed neutral position transfer switch.

A.4.2.15 See Section 230-95(b) of NFPA 70, *National Electrical Code.*

A.4.2.16 Standards for nonautomatic transfer switches are similar to those for automatic transfer switches, as defined in Section 2.1, with the omission of automatic controls.

A.4.4.3 See Section 700-3 of NFPA 70, *National Electrical Code.*

A.4.4.4 Consideration should be given to the effect that load interruption could have on the load during maintenance and service of the transfer switch.

A.4.5.1 It is important that the various overcurrent devices be coordinated, as far as practicable, to isolate faulted circuits and to protect against cascading operation on short circuit faults. In many systems, however, full coordination is not practicable without using equipment that could be undesirable for other reasons or prohibitively costly. Primary consideration also should be given to prevent overloading of equipment by limiting the possibilities of large current inrushes due to instantaneous reestablishment of connections to heavy loads.

A.4.5.3 See 6.6.5 of NFPA 20, *Standard for the Installation of Staationary Pumps for Fire Protection.*

A.5.1.1 The performance of the emergency power supply (EPS) and the EPSS is dependent on many factors, one of which is correct initial installation, primarily as the installation relates to the location and environmental conditions. Although this standard is not intended to serve

as a design standard for EPSS installation and environmental considerations, certain minimum standards are recognized as essential for successful start-up and performance, safe operation, and utilization of the EPSS where required.

A.5.1.2 The environmental conditions to be considered in the EPSS design should include, but not be limited to, heating, ventilating, and air-conditioning systems, protection from floods, fire, vandalism, wind, earthquakes, lightning, and other similar or applicable environmental conditions common to geographic locations and other factors affecting the location of the EPSS equipment.

The probability and frequency of power failures that do or can occur as a result of lightning, wind, and rain produced by thunderstorms, hurricanes, tornadoes, and similar weather conditions associated with the user's geographic location should be considered.

A.5.2.3 EPSS equipment should be located above known previous flooding elevations where possible.

A.5.2.4 When installing the EPSS equipment and related auxiliaries, environmental considerations should be given, particularly with regard to the installation of the fuel tanks and exhaust lines, or the EPS building, or both.

To protect against disruption of power in the facility, it is recommended that the transfer switch be located as close to the load as possible. The following are examples of external influences:

(a) Natural conditions
(1) Storms
(2) Floods
(3) Earthquakes
(4) Tornadoes
(5) Hurricanes
(6) Lightning
(7) Ice storms
(8) Wind
(9) Fire

(b) Human-caused conditions
(1) Vandalism
(2) Sabotage
(3) Other similar occurrences

(c) Material and equipment failures

A.5.2.4(a) EPSS design should consider the "100-year storm" flooding level or the flooding level predicted by the SLOSH models for a Class 4 hurricane.

A.5.3.3 Where units housed outdoors are used, it is recommended that a flashlight or battery-powered light with a flexible cord be maintained in the housing.

A.5.5 Generally, integral rubber vibration isolators are used on the rotating energy converters and spring-type or pad-type isolators are used on the larger energy converter units. In some cases, high deflection spring-type isolators should be used where a high degree of vibration attenuation is required. The EPS manufacturer should be consulted when considering the specific type of vibration control. Inertia bases should be considered where unusual vibration conditions are anticipated.

A.5.6 Generally, exhaust noises can be attenuated by using the proper mufflers. The mufflers used should be in accordance with the EPS manufacturer's recommendations. Depending on the degree of silencing required, the muffler should be rated accordingly for "commercial," "semicritical," and "critical" (high degree of silencing) service. To attenuate other noises, line-of-sight barriers having acoustical treatment or total acoustical enclosures can be used. The EPS should be installed away from critical areas.

A.5.7.1 During operation, EPS and related equipment reject considerable heat that needs to be removed by proper ventilation or air-cooling. In some cases, outdoor installations rely on natural air circulation, but enclosed installations need properly sized, properly positioned ventilation facilities, to prevent recirculation of cooling air. The optimum positions of air-supply louvers and radiator air discharge are on opposite walls, both to the outdoors.

A.5.8.2 It should be recognized that the reliability of municipal water-cooling is strictly dependent upon the reliability of the water utility. It should also be recognized that, during such natural disasters as earthquakes and floods, the water supply can be interrupted simultaneously with the primary electric power supply. Methods of cooling the energy convertor(s) consist of radiator cooling, either unit-mounted or remote, utility-furnished (city) water-cooling, heat exchangers, and air-cooling.

A.5.9.1.3 See Table A.5.9.1.3.

Table A.5.9.1.3 ASTM Fuel Oil Rating (diesel)

Rating	Fuel Description
A-2	Refinery fresh fuel
A-3	Good
A-4	Watch closely – aging has begun
A-5	Advanced aging and oxidization
A-6	Badly aged – not recommended
A-7	Severe aging – do not use

A.5.9.7 See NFPA 37, *Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines*; NFPA 54, *National Fuel Gas Code*; and NFPA 58, *Liquefied Petroleum Gas Code*.

A.5.9.8 Valving for natural gas-fueled prime movers should be configured so that the gas supply to the primer mover cannot be inadvertently or intentionally shut off by anyone other the qualified personnel such as the gas supplier. Placing valves in an isolated area, a secure area or locking the valve(s) open is recommended.

A.5.10.1 See NFPA 37, *Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines*.

A.5.10.3 Consideration should also be given to utilizing dampening supports where it is necessary to reduce exhaust noise vibration transmission.

A.5.11.2 If a fire suppression system is used in EPS rooms or separate buildings housing EPS equipment, consideration should be given to preaction-type suppression systems.

A.5.11.3 See NFPA 72, *National Fire Alarm Code*®.

A.5.11.5 Consideration should be given to the location of the EPS equipment, both as it relates to the building structure and to the effects of an earthquake.

All emergency power equipment support or subsupport systems should be designed and constructed so that they can withstand static or anticipated seismic forces, or both, in any direction, with the minimum force value used being equal to the equipment weight.

Bolts, anchors, hangers, braces, and other restraining devices should be provided to limit earthquake-generated differential movements between the EPS nonstructural equipment and the building structure. However, the degree of isolation required for vibration and acoustical control of the EPS equipment and other equipment should be maintained.

Suspended items such as piping, conduit, ducts, and other auxiliary equipment related to the EPSS should be braced in two directions to resist swaying and excessive movement in earthquake risk areas.

Battery racks for EPS equipment and electrical items or related auxiliaries, or both, should be designed to resist internal damage and damage at the equipment supports resulting from earthquake-generated motion. Battery racks should be capable of withstanding seismic forces equal to the supported weight in any direction. Batteries should be restrained to their support to prevent vibration damage, and electrical

interconnections should be provided with adequate slack to accommodate all relative deflections.

Transfer switch enclosures should be mounted so that their anchors and support structures can withstand static forces equal to the anticipated seismic shock in any direction.

Transfer switch components should be of the type that resist malfunction during dynamic excitation and should be designed to resist the anticipated seismic shock.

Where possible, EPS equipment and associated cooling systems and controls should be mounted on a single frame. The frame, in turn, should be rigidly attached to its foundation so that its anchorage can withstand static forces equal to the equipment weight in any direction. Where engine generator sets and associated cooling systems' controls cannot be mounted as an integral unit, each should be secured to meet the above floating requirements. Equipment not using the preferred rigid mounting should have vibration isolators with restraints capable of withstanding static forces equal to twice the weight of the supported equipment in any direction. In addition, interconnecting power, fuel, and cooling lines should be provided with adequate flexibility to allow maximum anticipated excursions without damage.

Appendages to the EPS equipment, such as day tanks, should be mounted to withstand static forces equal to the anticipated seismic shock in any direction.

A.5.11.6 Seismic shock should be simulated at the factory or in a testing laboratory on a prototype unit. Simulation should consist of a test(s) approximating actual time-history records of known seismic shocks applied to the equipment under test. Subassemblies of the total equipment could be tested separately where it is neither practical nor feasible to test the complete unit.

A.5.12.1 See NFPA 70, *National Electrical Code*.

A.5.12.2 See Chapter 3 of NFPA 99, *Standard for Health Care Facilities*.

A.5.13.2.3 See A.4.2.10.

A.6.1 The continuing reliability and integrity of the EPSS are dependent on an established program of routine maintenance and operational testing.

A.6.2 Where adequately secured from public access, it is desirable to locate an instruction manual, special tools and testing devices, and spare parts in the room in which the emergency power supply is located. The articles should be mounted at a convenient location on a wall and should be enclosed in a metal or other suitable cabinet. The cabinet should accommodate the instruction manual on the inside of the door.

A.6.3.1 The suggested maintenance procedure and frequency should follow those recommended by the manufacturer. In the absence of such recommendations, the Figures A.6.3.1(a) and (b) indicate alternate suggested procedures.

Existing A-6-3.1(a) (no change)
Figure A.6.3.1(a) Suggested maintenance schedule for Level 1 and Level 2 emergency power supply systems.

Existing A-6-3.1(b) (no change)
Figure A.6.3.1(b) Maintenance log — routine maintenance, operation, and testing (RMOT).

A.6.3.5 Where sealed devices are used, replacement of the complete device might be necessary. (See NFPA 70B, *Recommended Practice for Electrical Equipment Maintenance*.)

A.6.3.6 For existing systems that do not meet the requirements of Table 3.6.5.2 a battery load test should be performed quarterly by placing a recording voltmeter across the terminals of each starting (cranking) battery while the EPS is started. An excessive voltage drop of more than 20 percent of nominal voltage should be reason to investigate the integrity of the battery.

A.6.4.1 See Figures A.6.4.1(a) and (b).

Existing A-6-4.1(a) (no change)
Figure A.6.4.1(a) Operation and testing log for rotating equipment.

Existing A-6-4.1(b) (no change)
Figure A.6.4.1(b) Suggested operation and testing procedures for Level I and Level 2 rotating equipment.

A.6.4.2 Light loading creates a condition termed *wet stacking*, indicating the presence of unburned fuel or carbon, or both, in the exhaust system. Its presence is readily indicated by the presence of continual black smoke during engine-run operation. The testing requirements of 6.4.2 are intended to reduce the possibility of wet stacking.

A.6.4.6 Circuit breakers should be tested under simulated overload conditions every 2 years.

A.6.5.6 For Level 1 and Level 2 systems located outdoors, the manual shutdown should be located external to the weatherproof enclosure and should be appropriately identified.

Annex B Diagrams of Typical Systems

This Annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

B.1 See Figures B.1(a) through (d) for examples of typical power supply systems.

Existing B-1 (no change)
Figure B.1(a) Typical rotating emergency power supply system.

Existing B-2 (no change)
Figure B.1(b) Typical multiple-unit emergency power supply system.

Existing B-3 (no change)
Figure B.1(c) Typical uninterruptible power supply system (UPS).

Existing B-4 (no change)
Figure B.1(d) Typical composite emergency power supply system.

Annex C Referenced Publications

C.1 The following documents or portions thereof are referenced within this standard for informational purposes only and are thus not considered part of the requirements of this standard unless also listed in Chapter 7. The edition indicated here for each reference is the current edition as of the date of the NFPA issuance of this standard.

C.1.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection*, 1999 edition.

NFPA 37, *Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines*, 1998 edition.

NFPA 54, *National Fuel Gas Code*, 1999 edition.

NFPA 58, *Liquefied Petroleum Gas Code*, 2001 edition.

NFPA 70, National Electrical Code®, 1999 edition.

NFPA 70B, *Recommended Practice for Electrical Equipment Maintenance*, 1998 edition.

NFPA 72, *National Fire Alarm Code®*, 1999 edition.

NFPA 99, *Standard for Health Care Facilities*, 1999 edition.

NFPA *101®*, *Life Safety Code®*, 2000 edition.

NFPA 111, *Standard on Stored Electrical Energy Emergency and Standby Power Systems*, 2001 edition.

C.1.2 Other Publications.

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