TO:                      NFPA Technical Committee on Electrical Systems
FROM:                    Jeanne Moreau-Correia
DATE:                    March 2, 2010
SUBJECT:                 NFPA 99 A11 ROP Letter Ballot

The ROP letter ballot for NFPA 99 HEA-ELS is attached. The ballot is for formally voting on whether or not you concur with the committee’s actions on the proposals. Reasons must accompany all negative and abstention ballots.

Please do not vote negatively because of editorial errors. However, please bring such errors to my attention for action.

Please complete and return your ballot as soon as possible but no later than Monday, March 15, 2010. As noted on the ballot form, please submit the ballot to Jeanne Moreau-Correia, e-mail to jmoreaucorreia@nfpa.org or fax to 617-984-7110.

The return of ballots is required by the Regulations Governing Committee Projects.

Attachment: Proposals
**Technical Committee on Electrical Systems,**

**Recommendation:** Revise the term "wet location" to "wet procedure location" throughout the document.

**Substantiation:** The term 'wet location' is used and defined in Article 100 of NFPA 70, and has a different definition. The term as used in NFPA 99 has a different intent than that in NFPA 70. The Standards Council policy is not to have terms defined differently in NFPA documents. Changing the term as used in NFPA 99 will eliminate this confusion as well indicate more clearly the intent of the term as used in NFPA 99.

**Committee Meeting Action:** Accept

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**Technical Committee on Electrical Systems,**

**Recommendation:** Add a new definition for receptacle. This definition will be extracted from Article 100 in the 2008 edition of NFPA 70 and reads:

> Receptacle. A receptacle is a contact device installed at the outlet for the connection of an attachment plug. A single receptacle is a single contact device with no other contact device on the same yoke. A multiple receptacle is two or more contact devices on the same yoke. [70:100]

**Substantiation:** This term is used in Chapter 4 requirements covering the minimum number of receptacles. Placing this extracted definition in NFPA 99 provides the user of this standard with this necessary definition.

**Committee Meeting Action:** Accept

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**Technical Committee on Electrical Systems,**

**Recommendation:** Revise to read as follows:

4.3.2.6.2(A) Receptacles for Patient Bed Locations in General Care Areas (Category 2). Each patient bed location shall be provided with a minimum of eight receptacles.

**Substantiation:** Modern health care facilities demand more receptacles at the bedside due to increase use of equipment.

**Committee Meeting Action:** Accept

**Committee Statement:** See section 6.3.2.2.6.2(A) in the preprint.

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**Glossary of Terms Technical Advisory Committee / Marcelo Hirschler,**

**Recommendation:** Revise 3.3.15 as follows:

> Performing Providing a function without the necessity of human intervention. (ELS)

**Substantiation:** This proposal is intended to generate consistent definitions and minimize the number of duplicate definitions in the NFPA Glossary of Terms in accordance with the scope of the NFPA Glossary of Terms Technical Advisory Committee.

**Committee Meeting Action:** Accept
99-38  Log #54  HEA-ELS  (3.3.41 Emergency System)  Final Action: Reject

Submitter: Burton R. Klein, Burton Klein Associates

Recommendation: Revise the title of 3.3.41 from "Emergency System" to "Emergency System (HCF)".
Substantiation: To distinguish from the term as used in Article 700 in NFPA 70 from that as used in Sections 4.4, 4.5, and 4.6 in NFPA 99.
Committee Meeting Action: Reject
Committee Statement: This term will be deleted. See Committee Proposal 99-39 (Log #CP312).

99-39  Log #CP312  HEA-ELS  (3.4.1 Emergency System)  Final Action: Accept

Submitter: Technical Committee on Electrical Systems,
Recommendation: Replace the term "Emergency System" throughout the document with "Life Safety Branch and Critical Branch" and delete definition 3.3.41 Emergency System.
Substantiation: This avoids any further confusion with term "emergency system" as used in Article 700 in NFPA 70.
Committee Meeting Action: Accept

99-40  Log #CP321  HEA-ELS  Final Action: Accept
(3.3.44 Essential Electrical System, Critical Branch, Critical System, Equipment System, Life Safety Branch, Figure B.4.1)

Submitter: Technical Committee on Electrical Systems,

Recommendation: Revise and delete definitions as follows:

Revise Critical Branch as follows: Critical Branch – A system of feeders and branch circuits supplying power for task illumination, fixed equipment, select receptacles, and select power circuits serving areas and functions related to patient care that are automatically connected to alternate power sources by one or more transfer switches during interruption of the normal power source.

Delete the term "Critical System"

Change the term "Equipment System" to "Equipment Branch"

Add annex material to 3.3.44 Essential Electrical System as follows: "The Essential Electrical System can be comprised of three branches: life safety branch, critical branch, and equipment branch."

Revise Life Safety Branch as follows: A system of feeders and branch circuits supplying power for lighting, receptacles, and equipment essential for life safety that are automatically connected to alternate power sources by one or more transfer switches during interruption of the normal power source.

Delete "Quiet Ground".

Revise Figure B.4.1 as follows: Change "Equipment System" to Equipment Branch. Change "Emergency System" to independent designations for "Life Safety Branch" and "Critical Branch".

Substantiation: Critical branch definition was changed as it replaces part of Emergency System.

The term "Critical System" was deleted as it is no longer used in the standard.

The term "Equipment System" was changed to correlate with changes of terminology within Chapter 4.

Annex material was added to 3.3.44 for consistency with changes made to Chapter 4.

Life Safety Branch was modified to be consistent with changes made to Chapter 4.

Quiet Ground was deleted as this term was changed to isolated ground within Chapter 4.

Figure B.4.1 was modified to be consistent with changes made to Chapter 4.

Committee Meeting Action: Accept

99-44  Log #414  HEA-ELS  Final Action: Accept in Principle
(3.3.63 Ground-Fault Circuit-Interrupter (GFCI))

Submitter: James M. Daly, General Cable

Recommendation: Add text as follows:

Add the word "fault" as shown:

Ground-Fault Circuit-Interrupter (GFCI). A device intended for the protection of personnel that functions to de-energize a circuit or portion thereof within an established period of time when a fault current to ground exceeds some predetermined value that is less than that required to operate the overcurrent protective device of the supply circuit.

Substantiation: This proposal is intended to generate consistent definitions and minimize the number of duplicate definitions in the NFPA Glossary of Terms.

The proposed wording should meet the intent of 3 preferred and 2 secondary definitions used in 8 NFPA Standards.

Similar proposals are being submitted to NFPA 70, 70B, 70E, 73, 99B, 302, and 1901.

Committee Meeting Action: Accept in Principle

Revise to read as follows:

Ground-Fault Circuit-Interrupter (GFCI).

A device intended for the protection of personnel that functions to de-energize a circuit or portion thereof within an established period of time when a current to ground exceeds the values established for a Class A device. [70: ]

Committee Statement: This revision is to correlate with the Glossary of Terms.
99-47 Log #CP326 HEA-ELS Final Action: Accept
(3.3.85 Isolated Power System)

**Submitter:** Technical Committee on Electrical Systems,
**Recommendation:** Revise to read:
3.3.85* Isolated Power System. A system comprising an isolation transformer or its equivalent, a line isolation monitor, and its ungrounded circuit conductors. (ELS)

**Substantiation:** Isolation Transformer* is a term defined, in this document (see 3.3.86) and used throughout other documents, such as UL Standards. "Isolating transformer" is not defined.
**Committee Meeting Action:** Accept

99-72 Log #395 HEA-ELS Final Action: Reject
(3.3.185 (New))

**Submitter:** Jan Ehrenwerth, Yale University School of Medicine
**Recommendation:** Add new text as follows:
An Anesthetizing location (See 3.3.9) where surgical procedures are performed shall be considered a wet location.

**Substantiation:** The modern operating room is filled with electronic life support equipment. This equipment is vital for the safe care of a patient during surgery and anesthesia. In addition, there are frequent instances of standing pools of saline, water, blood and urine on the floor. Also intravenous fluids frequently drip on electronic equipment. The surgeons use irrigating fluids in many procedures. These fluids often end up on the floor. Major surgical procedures, trauma and transplant surgery often are associated with large amounts of blood loss. This blood can easily end up on the floor. The result is that modern operating rooms frequently have conductive fluids on the floor and this presents a hazard to OR personnel and patients. Most operating rooms also have hot air warmers for patients. These devices are often mounted on IV poles where fluids can drip on them. We recently had one of these devices short circuit and blow smoke into the operative field. Since the device was connected to an isolated power system, the line isolation monitor alerted all personnel to a problem, and limited the current flow probably preventing a fire. It is essential that modern operating rooms have the added protection of isolated power or at a minimum ground fault circuit interrupters. This would be accomplished by recognizing operating rooms as wet locations.

**Committee Meeting Action:** Reject
**Committee Statement:** The Manual of Style does not allow requirements to be in the definition.

99-73 Log #29 HEA-ELS Final Action: Accept in Principle
(3.3.185 Wet Location)

**Submitter:** Burton R. Klein, Burton Klein Associates

**Recommendation:** 1. Revise term "Wet Location" to read "Wet (Procedure) Location."
2. Change term "wet location" to "wet (procedure) location" wherever it appears in text: 4.3.2.2.8, 4.3.2.2.8.1, 4.3.2.2.8.2, 8.5.2.1.2.2, 13.2.4, 13.4.1.2.6.1(F), A.3.3.185, (also in the Origin and Development of NFPA 99).

**Substantiation:** Term "wet location" is used and defined in Article 100 of NFPA 70, and has a different definition. Term as used in NFPA 99 has a different intent than that in NFPA 70. In NFPA 99, intent is to identify certain patient care areas (1) where patients are present and being treated, (2) where electrical equipment is being used, and (3) where there are standing fluids on the floor. The Standards Council has a policy not to have terms defined differently in NFPA documents. Changing term used in NFPA 99 will eliminate this confusion with term as used in NFPA 70 (except in Article 517 where term is used in the same way as in NFPA 99), as well indicate more clearly the intent of the term as used in NFPA 99.
A proposal has been submitted on NFPA 70 to correlate this change.

**Committee Meeting Action:** Accept in Principle
**Committee Statement:** See the action on Committee Proposal 99-8 (Log #CP302).
99-75 Log #40 HEA-ELS
(Chapter 4) Final Action: Accept in Principle

Submitter: Burton R. Klein, Burton Klein Associates

Recommendation:
1. Delete 4.3.4, 4.4.4, 4.5.4, and 4.6.4 from Chapter 4.
2. Create new Chapter 5, titled "Electrical System requirements for existing facilities."
3. Insert 4.3.4, 4.4.4, 4.5.4 into new Chapter 5, renumbered as Sections 5.1, 5.2, 5.3, and 5.4, respectively.
4. Revise title of Chapter 4 to "Electrical system requirements for new facilities."
5. Renumber current Chapters 5 to 21 as 6 to 22, respectively.

Substantiation: Make it easier for users and enforcers of document to see which requirements are applicable to new facilities, and which are applicable to existing facilities. (In the similar fashion to arrangement in NFPA 101.)

Committee Meeting Action: Accept in Principle
Committee Statement: See action on Committee Proposal 99-78 (Log #CP318).

99-76 Log #201 HEA-ELS
(Chapter 4) Final Action: Reject

Submitter: Dale Woodin, American Society for Healthcare Engineering

Recommendation:

***Include-L201-Rec***

(Include has 2 figures Fig. C.4.1 & C.4.2 and one equation)

Substantiation: The attached revised chapter is the output of a two year effort of ASHE members (owners, designers, and installers) to streamline and clarify this chapter. Because this is a total revision of the chapter it is extremely difficult to identify the revisions through strike through and underline text. ASHE’s hope is the technical committee will engage in a discussion with ASHE on the specific points and sections of this proposed revision.

This is not original material; its reference/source is as follows:
I am proposing this chapter on behalf of the ASHE Power Distribution Workgroup

Committee Meeting Action: Reject
Committee Statement: There are numerous technical changes embedded within this document that have not been substantiated by the submitter. The committee encourages the submitter to identify the technical changes and provide comments with technical substantiation to support the proposed changes.
NFPA 99 Chapter 4
ASHE Committee re-write Electrical Systems Portions

4.1 Applicability.
4.1.1 Applicability: This chapter applies to health care facilities and Plant buildings that supply utilities directly to healthcare facilities.

4.1.2 Definitions.
4.1.2.1 Anesthetizing location: critical care patient areas designated by the governing body of the hospital as areas in which inhalation anesthetics are administered, creating enhanced risks.

4.1.2.2 Building: Any structure used or intended for supporting or sheltering any use of occupancy. A building, as defined here, may include one or more contiguous buildings when the contiguous buildings are considered to be separate structures that are tied together, and it may include contiguous buildings separated by fire partitions.

4.1.2.3 Campus: A collection of buildings, with the same or different occupancies, residing on adjacent parcels of land, and sharing ownership, operation, and/or utility services.

4.1.2.4 Campus feeder: the conductors from a plant building to other buildings on a campus.

4.1.2.5 Campus service: The conductors and equipment for delivering electrical energy from the serving utility to the first service point of the campus served.

4.1.2.6 Critical Patient Care Areas. Those special care units, intensive units, coronary care units, angiography laboratories, cardiac catheterization laboratories, delivery rooms, operating rooms, post anesthesia recovery rooms, emergency departments, and similar areas in which patients are intended to be subjected to invasive procedures and connected to line-operated patient-care-related electrical appliances.

4.1.2.7 Essential Distribution System: A system comprised of all distribution systems and ancillary equipment, designed to ensure continuity of electrical power to designated areas and functions of a health care facility required by other sections of this document, during disruption of normal power sources, and also designed to minimize disruption within the internal wiring system.

4.1.2.8 General Patient Care Areas. Patient bedrooms, examining rooms, treatment rooms, clinics, and similar areas in which it is intended that the patient will come into contact with ordinary appliances such as nurse-call systems, electric beds, examination lamps, telephones, and entertainment devices. (ELE)

4.1.2.9 Health Care Facilities. Buildings or portions of buildings in which medical, dental, psychiatric, nursing, obstetrical, or surgical care are provided. (ADM)

4.1.2.10 Hospital Building: A building or portion thereof used on a 24-hour basis for the medical, psychiatric, obstetrical, or surgical care of four or more inpatients.

4.1.2.11 Isolated Power system: a separately derived power distribution system whose neutral is ungrounded.

4.1.2.12 Non-essential distribution system: all distribution systems serving only loads not required by this document to have ensured continuity of electrical power during disruption of normal power sources.

4.1.2.13 Normal Source: The preferred source of power to the site, or portion of the site.

4.1.2.14 Plant: A building, or portion of a building whose primary purpose is to house energy generation, transformation, and distribution equipment serving one or more buildings on a campus.

4.1.2.15 Plant Building: A building whose primary purpose is to house energy generation, transformation, and distribution equipment for a campus. The building may house other functions, such as shops, offices for facility staff, etc, but the primary purpose must be to house the equipment listed above.
4.2 General requirements.
4.2.1 Distribution Equipment
4.2.2 Provide labels at each switchboard, panelboard, motor control center, and other load distribution equipment indicating the name of the device, the source for power for the device, and the branch or system for the device. Similarly, label all feeder devices in the distribution equipment indicating the load served. Branch Circuit panels may use panel schedules for the latter purpose.

4.2.3 Devices and circuits
4.2.3.1 Receptacles
4.2.3.1.1 Minimum Number of Receptacles.
4.2.3.1.1.1 Each general patient care area shall be provided with a minimum of four single receptacles or two duplex receptacles.
4.2.3.1.1.2 Each Critical patient care area shall be provided with a minimum of six single receptacles or three duplex receptacles. At least one duplex, or two single receptacles shall be served by the essential distribution system for the space. At least one duplex, or two single receptacles shall be served by the Non-Essential System.
4.2.3.1.1.3 Receptacles shall not be required in bathrooms or toilet rooms.
4.2.3.1.4 Provide a minimum of four single receptacles or two duplex receptacles, including one duplex or two single receptacles served by the essential distribution system, and provide task lighting served by the essential distribution system in the following spaces:
4.2.3.1.4.1 Medication preparation areas.
4.2.3.1.4.2 Pharmacy dispensing areas.
4.2.3.1.4.3 Nurses' stations
4.2.3.1.4.4 General patient care sleeping rooms
4.2.3.1.4.5 Angiographic labs.
4.2.3.1.4.6 Cardiac catheterization labs.
4.2.3.1.4.7 Coronary care units.
4.2.3.1.4.8 Hemodialysis rooms or areas.
4.2.3.1.4.9 Emergent room treatment areas (selected)
4.2.3.1.4.10 Human physiology labs.
4.2.3.1.4.11 Post operative recovery rooms (selected)
4.2.3.1.5 Nurse call systems
4.2.3.1.6 Blood, bone, and tissue banks.
4.2.3.1.7 Telephone and patient care data equipment rooms and closets.
4.2.3.1.8 Receptacles shall not be required in areas where medical requirements mandate otherwise (e.g. certain psychiatric, pediatric, or hydrotherapy areas).
4.2.3.1.9 Do not use GFI devices for receptacles providing power in areas that cannot tolerate interruption of power under fault conditions.
4.2.3.1.10 Provide labels at each wiring device in rooms used for delivering patient care. Labels shall indicate the branch (or system), circuit, and panel serving that wiring device, or equipment. FPN: Wiring devices include equipment disconnect switches, receptacles, and light switches.
4.2.3.1.11 The electrical receptacles or the cover plates for the electrical receptacles supplied from the emergency system shall have a distinctive color or marking so as to be readily identifiable.
4.2.3.2 Circuits – general patient care area.
4.2.3.3 Do not supply receptacles serving a patient care area from a circuit that also serves other loads such as housekeeping.
4.2.3.4 Circuits – critical patient care area.
4.2.3.4.1 Do not supply receptacles serving a patient care area from a circuit that also serves other loads such as housekeeping.
4.2.3.4.2 Critical patient care areas shall have at least one branch circuit from a critical branch lighting and appliance branch circuit panelboard and at least one branch circuit from either a non-critical
essential lighting and appliance branch circuit panel. or from a critical branch lighting and
appliance branch circuit panelboard served from a different automatic transfer switch from the
first critical branch circuit.
4.2.3.4 Branch circuits serving only special purpose outlets or receptacles (e.g. receptacles for
portable X-ray) need not conform to 4.2.1.3.1.
4.2.3.4.4 Installed wiring shall be in metal raceway.
4.2.3.4.5 In anesthetizing locations, provide one or more battery-powered emergency lighting
units as required in Section 700.12(E) of NFPA 70, National Electrical Code. Such lights shall be
wired to circuits serving general area lighting.
4.2.4 Grounding.
4.2.4.1 Grounding Circuit Integrity. Grounding circuits and conductors to patient care areas shall
be installed in such a way that the continuity of other parts of those circuits cannot be interrupted
nor the resistance raised above 1 ohm by the installation, removal, and replacement of any
installed equipment, including power receptacles.
4.2.4.2 Separate Grounding Conductor. Provide grounding conductors conforming to NFPA 70,
National Electrical Code, in all power circuits to power receptacles in General and Critical
Patient care areas.
4.2.4.3 Each device connected to the distribution system shall be effectively grounded to the
metal raceway at the device.
4.2.4.4 When existing construction contains circuits in General and Critical Patient Care Areas
that do not contain a separate grounding conductor, the continued use of the system shall be
permitted, provided the resistance from the device to ground meets the performance requirements
of 4.2.4.1.
4.2.4.5 When metal receptacle boxes are used, the performance of the connection between the
receptacle grounding terminal and the metal box shall be equivalent to the performance provided
by copper wire no smaller than 12 AWG.
4.2.4.6 Grounding Interconnects. Bond the ground busses together of all branch circuit panels
serving any patient care area.
4.2.4.6.1 When renovating a space, ensure that panel ground busses are bonded, particularly if
one circuit originates in a panel not already serving the area.
4.2.5 Overcurrent protection
4.2.5.1 Where ground-fault protection is provided for operation of the service or feeder
disconnecting means for buildings that contain critical care areas or that use life support
equipment, and for central plant buildings serving such buildings provide an additional step of
ground-fault protection in the next level of feeder downstream toward the load.
4.2.5.2 Do not provide ground fault interruption devices in the distribution system downstream of
Transfer Switches, except as required for branch devices in wet locations.
4.2.5.3 The main and downstream ground-fault protective devices (where installed) shall be
selectively coordinated in the long-time portion of the time-current curves with all supply-side
over-current protective devices. Coordination shall not be required in the current limiting or
instantaneous portions of the time-current curves.
4.2.5.4 Provide reasonable accessibility to branch-circuit switching and overcurrent protection
devices by the hospital staff in the patient care area. Protect these devices from public access.
4.2.6 Wet locations
4.2.6.1 The only areas in a hospital considered to be wet locations are hydrotherapy, shower/tub
rooms, and other rooms containing large amounts of water in pools or other similar containers.
4.2.6.2 Patient bed rooms shall not be considered wet locations.
4.2.6.3 Any receptacles within 6 ft of a sink or other plumbing fixture must be GFCI type.
4.2.7 Isolated power systems (IPS)
4.2.7.1 Where a healthcare facility administration or designee determines that a particular room
presents unusual electrical hazards, or where continuity of service is essential for patient safety
and subject to the potential for frequent interruption, the use of an isolated power system shall be permitted.

4.2.7.1.1 Potential hazards include:

- Flammable anesthetics
- Patient vulnerability
- Equipment being used in the space
- Frequency of presence of large amounts of uncontained fluids
- Dependence of patient on reliability of service of electrical equipment
- Ungrounded power systems are also known as Isolated power system (IPS).
- An isolation transformer shall not serve more than one operating room. Isolation transformers shall be permitted to serve single receptacles in several patient areas when the receptacles are reserved for supplying power to equipment requiring 150 V or higher (e.g., items such as portable lasers) and when the receptacles and mating plugs are not interchangeable with the receptacles on the local isolated power system.

4.2.7.2 Isolation transformers

4.2.7.2.1 The isolation transformer shall be listed and approved for the purpose.

4.2.7.2.2 The primary winding shall be connected to a power source so that it is not energized with more than 600 V (nominal). The neutral of the primary winding shall be grounded in an approved manner. If an electrostatic shield is present, it shall be connected to the reference grounding point.

4.2.7.3 Wiring for isolated power systems shall conform to NFPA 70, National Electrical Code.

4.2.7.3.1 In areas using receptacles on isolated and grounded power, all receptacles shall be identified as to whether they are on isolated or grounded power.

4.2.7.3.2 Switches controlling ungrounded circuits within or partially within an inhalation anesthetizing location shall have a disconnecting pole for each conductor.

4.2.7.4 Line Isolation Monitor

4.2.7.4.1 In addition to the usual control and protective devices, each isolated power system shall be provided with an approved continually operating line isolation monitor that indicates possible leakage or fault currents from either isolated conductor to ground.

4.2.7.4.2 The monitor shall be designed such that a green signal lamp, conspicuously visible in the area where the line isolation monitor is utilized, remains lighted when the system is adequately isolated from ground; and an adjacent red signal lamp and an audible warning signal (remote if desired) shall be lit when the total hazard current (consisting of possible resistive and capacitive leakage currents) from either isolated conductor to ground reaches a threshold value of 5.0 mA under normal line voltage conditions. The line isolation monitor shall not alarm for a fault hazard current of less than 3.7 mA.

4.2.7.4.3 The line isolation monitor shall comply with either of the following:

- It shall have sufficient internal impedance such that, when properly connected to the isolated system, the maximum internal current that will flow through the line isolation monitor, when any point of the isolated system is grounded, shall be 1 mA.

- It shall be permitted to be of the low-impedance type such that the current through the line isolation monitor, when any point of the system is grounded, will not exceed twice the alarm threshold value for a period not exceeding 5 msec.

4.2.7.4.4 An ammeter connected to indicate the total hazard current of the system (contribution of the fault hazard current plus monitor hazard current) shall be mounted in a plainly visible place on the line isolation monitor with the “alarm on” zone (total hazard current = 5.0 mA) at approximately the center of the scale. It is desirable to locate the ammeter such that it is conspicuously visible to persons in the anesthetizing location.

4.2.7.4.5 Means shall be provided for shutting off the audible alarm while leaving the red warning lamp activated. When the fault is corrected and the green signal lamp is reactivated, the audible
alarm silencing circuit shall reset automatically, or an audible or distinctive visual signal shall indicate that the audible alarm is silenced.

4.2.7.4.6 A reliable test switch shall be mounted on the line isolation monitor to test its capability to operate (i.e., cause the alarms to operate and the meter to indicate in the “alarm on” zone). This switch shall transfer the grounding connection of the line isolation monitor from the reference grounding point to a test impedance arrangement connected across the isolated line; the test impedance(s) shall be of the appropriate magnitude to produce a meter reading corresponding to the rated total hazard current at the nominal line voltage, or to a lesser alarm hazard current if the line isolation monitor is so rated. The operation of this switch shall break the grounding connection of the line isolation monitor to the reference grounding point before transferring this grounding connector to the test impedance(s), so that making this test will not add to the hazard of a system in actual use, nor will the test include the effect of the line to ground stray impedance of the system. The test switch shall be of a self-restoring type.

4.2.7.4.7 The line isolation monitor shall not generate energy of sufficient amplitude or frequency, as measured by a physiological monitor with a gain of at least $10^4$ with a source impedance of 1000 ohms connected to the balanced differential input of the monitor, to create interference or artifact on human physiological signals. The output voltage from the amplifier shall not exceed 30 mV when the gain is $10^4$. The 1000 ohms impedance shall be connected to the ends of typical unshielded electrode leads that are a normal part of the cable assembly furnished with physiological monitors. A 60 Hz notch filter shall be used to reduce ambient interference as is typical in physiological monitor design.

4.2.7.4.8 Identification of Conductors for Isolated (Ungrounded) Systems. The isolated conductors shall be identified in accordance with NFPA 70, National Electrical Code.

4.2.8 Infrastructure for electronic systems

4.2.8.1 Low-voltage wiring shall comply with either of the following:

4.2.8.1.1 Fixed systems of 30 V (dc or ac rms) or less shall be ungrounded, provided the insulation between each ungrounded conductor and the primary circuit, which is supplied from a conventionally grounded distribution system, is the same protection as required for the primary voltage.

4.2.8.1.2 A grounded low-voltage system shall be permitted provided that load currents are not carried in the grounding conductors.

4.2.8.2 Wiring for low-voltage systems shall not be required to be installed in metal raceways.

4.3 Essential Electrical System (EES)

4.3.1 The essential electrical system for a health care facility consists of the emergency power supply system (EPSS) and the emergency power system (EPS).

4.3.2 Emergency Power Supply (EPSS)

4.3.2.1 Essential electrical systems shall have a minimum of two independent sources of power; a normal source generally supplying the entire electrical system and one or more alternate sources for use when the normal source is interrupted.

4.3.2.1.1 Where the normal source consists of an external utility service, the alternate source shall be:

<table>
<thead>
<tr>
<th>Load</th>
<th>Generator set or batteries</th>
<th>Generator Set or batteries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 150 kva</td>
<td>Building includes critical care areas or areas for overnight stay</td>
<td></td>
</tr>
<tr>
<td>150 kva or greater</td>
<td>Building includes general care areas only</td>
<td></td>
</tr>
</tbody>
</table>

99/L201/R/A2011ROP
4.3.2.2 Where the normal source consists of generating units on the premises, the alternate source shall be another generating set.

4.3.2.3 Generator sets shall be classified as Type 10, Class X, Level 1 generator sets per NFPA 110, Standard for Emergency and Standby Power Systems, subject to the following:

4.3.2.3.1 Energy converters shall be designed, assembled, and tested to ensure system operation under all conditions listed in NFPA 110, Standard for Emergency and Standby Power Systems.

4.3.2.3.2 Use of multiple generators is acceptable.

4.3.2.3.3 Fuel capacities for Class X run hours shall be based on maximum calculated demand load.

4.3.2.3.4 The EPSS shall be permitted to load shed all or portions of the equipment system upon the failure of one or more generators.

4.3.2.3.5 One unit of a paralleling generator system shall be sized for the demand load of the Life Safety and Critical Branches of the Emergency System (where present), as well as medical air compressors, medical surgical vacuum pumps, electrically operated fire pumps, and jockey pumps.

4.3.2.3.6 If rated for standby use, the generating equipment used shall be reserved exclusively for such service.

4.3.2.3.7 If rated for continuous use, the generating equipment may be used for other purposes of peak demand control, internal voltage control, load relief for the external utility, or cogeneration without restriction.

4.3.2.3.8 If rated for standby use, the generating equipment may be used for other purposes such as peak demand control, internal voltage control, load relief for the external utility, or cogeneration by adding redundancy to the system. This redundancy must consist of at least two sets, such that the maximum actual demand likely to be produced by the connected load of the emergency system as well as medical air compressors, medical surgical vacuum pumps, electrically operated fire pumps, jockey pumps, shall be met with the largest single generator set out of service.

4.3.2.3.9 EPSS component heating shall be in accordance with NFPA 110, Standard for Emergency and Standby Power Systems.

4.3.2.3.10 Remote Controls and Alarms: Remote controls and alarms shall be designed, manufactured and assembled, installed, operated, and tested in accordance with NFPA 110, Standard for Emergency and Standby Power Systems.

4.3.2.3.11 Transfer Switch Equipment: Transfer switch equipment shall be designed, manufactured, installed, operated, and tested in accordance with Section 6.2 of NFPA 110, Standard for Emergency and Standby Power Systems.
4.3.2.11 Load Switching (Load Shedding): Load switching (load shedding) shall be designed, manufactured, installed, operated, and tested in accordance with Section 6.3 of NFPA 110, Standard for Emergency and Standby Power Systems.

4.3.2.11.1 Comply with 6.2.5 and 6.2.7 of NFPA 110, Standard for Emergency and Standby Power Systems.

4.3.2.12 Bypass-Isolation Switches: Bypass-isolation switches shall be designed, manufactured, installed, operated, and tested in accordance with Section 6.4 of NFPA 110, Standard for Emergency and Standby Power Systems.

4.3.2.13 Protection: Protection shall be in accordance with Section 6.5 of NFPA 110, Standard for Emergency and Standby Power Systems.

4.3.2.14 Environmental Considerations: Installation and environmental considerations shall be in accordance with Sections 7.2 and 7.7 of NFPA 110, Standard for Emergency and Standby Power Systems.

4.3.2.14.1 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. [110: 7.1.2]

4.3.2.15 Fuel system design shall provide for a supply of clean fuel to the prime mover. [110: 7.9.1.2]

4.3.2.16 Tanks shall be sized based on local regulations with the following minimums:

4.3.2.17 Protection: Protection shall be designed, manufactured, installed, operated, and tested in accordance with Section 7.11 of NFPA 110, Standard for Emergency and Standby Power Systems.

<table>
<thead>
<tr>
<th>System load</th>
<th>Building contains critical care areas</th>
<th>Building contains patient sleeping areas</th>
<th>Building contains general patient care areas only</th>
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</thead>
<tbody>
<tr>
<td>Less than 150 kva</td>
<td>24 hours</td>
<td>12 hours</td>
<td>4 hours</td>
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<tr>
<td>150 kva or more</td>
<td>24 hours</td>
<td>24 hours</td>
<td>4 hours</td>
</tr>
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</table>

4.3.3 Emergency Power System (EPS)

4.3.3.1 The EPS shall consist of transfer switches, feeders, distribution equipment, and branch circuits providing power to loads that must remain on during a loss of utility power.

4.3.3.2 The EPS shall consist of the Emergency System and the Equipment System.

4.3.3.2.1 The Emergency System shall consist of the life safety branch and the critical branch.

4.3.3.2.1.1 The Life Safety Branch shall serve only loads essential to life safety.

4.3.3.2.1.2 The Critical Branch shall serve only loads critical to patient care.

4.3.3.2.2 The Equipment System shall supply major electrical equipment necessary for patient care.

4.3.3.3 The number of transfer switches to be used shall be based upon reliability, design, and load considerations. Each branch of the emergency system and each equipment system shall have at least one transfer switch. Loads for each branch or system may be served by one or more transfer switch, but in no instance may loads from one branch or system be served by the distribution system for another branch or system.

4.3.3.3.1 One transfer switch and distribution system shall be permitted to serve both systems in a facility with a continuous actual demand load on the switch of 150 KVA (120 kw) or less.

4.3.3.3.2 One transfer switch and distribution system shall be permitted to serve both branches of the emergency system in a facility when the cumulative loads for the two systems have a continuous actual demand load of 300 KVA (240 kw) or less.

4.3.3.4 The system shall be designed so that loads will be connected to the alternate source within the times specified below following loss of the normal source.
4.3.3.5 The EPS shall be designed to minimize interruptions to the electrical systems due to internal failures by the use of adequately rated equipment and transfer switches close to the loads served.

4.3.3.6 Life Safety Branch:

4.3.3.6.1 Following the loss of the normal source, Life Safety Branch loads will be connected to the alternate source within 10 seconds.

4.3.3.6.2 In no event, except automatic operation of an overcurrent protection device due to a fault, shall any life safety branch loads ever be shed.

4.3.3.6.3 Life Safety Branch loads shall consist of the following (when required by other regulations to be in the facility or when in the facility due to facility needs):

4.3.3.6.3.1 Building Fire/smoke control system (not fans).

4.3.3.6.3.2 Task illumination and receptacles for all mechanical and electrical spaces in the building.

4.3.3.6.3.3 Illumination of means of egress as required in NFPA 101, Life Safety Code.

4.3.3.6.3.4 Exit signs and exit direction signs required in NFPA 101, Life Safety Code.

4.3.3.6.3.5 Alarm and alerting systems including the following:

4.3.3.6.3.5.1 Fire alarms

4.3.3.6.3.5.2 Alarms required for systems used for the piping of non-flammable medical gases as specified in Chapter x, Gas and Vacuum Systems.

4.3.3.6.3.6 Communication systems, where used for issuing instruction during emergency conditions.

4.3.3.6.3.7 Generator set location. Task illumination, battery charger for emergency battery-powered lighting unit(s), and selected receptacles at the generator set location and essential electrical system transfer switch locations.

4.3.3.6.3.8 Generator accessories, including, but not limited to, the fuel transfer pump, electrically operated louvers, controls, cooling system, and other generator accessories essential for generator operation.

4.3.3.6.3.9 Elevator cab lighting, control, communication, and signal systems. Automatically operated doors used for building egress.

4.3.3.6.3.10 The auxiliary functions of fire alarm combination systems complying with NFPA 72, National Fire Alarm Code (including electrically operated dampers used for smoke control).

4.3.3.6.4 Following the loss of the normal source, Critical Branch loads will be connected to the alternate source within 15 seconds.

4.3.3.6.4.1 In no event, except automatic operation of an overcurrent protection device due to a fault, shall any critical branch loads ever be shed before shedding equipment system or non-essential system loads.

4.3.3.6.5 Critical Branch loads shall consist of the following (when required by other regulations to be in the facility or when in the facility due to facility needs):

4.3.3.6.5.1 Task illumination, selected receptacles, and selected fixed medical equipment.

4.3.3.6.7 Equipment System.

4.3.3.6.7.1 Following the loss of the normal source, Equipment System loads will be connected to the alternate source within 60 seconds.

4.3.3.6.7.2 Equipment system loads shall only be shed in the event that the alternate power supply has insufficient capacity to serve both the Emergency System and the Equipment System. In no event, except automatic operation of an overcurrent protection device due to a fault, shall any Equipment System loads ever be shed before shedding non-essential system loads.

4.3.3.6.7.3 Equipment System shall serve the following loads (if present):

4.3.3.6.7.3.1 Central suction systems serving medical and surgical functions, including controls.

4.3.3.6.7.3.2 Compressed air systems serving medical and surgical functions, including controls.

4.3.3.6.7.3.3 Smoke control and stair pressurization systems.
4.3.3.7.3.4 Kitchen hood supply and/or exhaust systems, if required to operate during a fire in or under the hood.
4.3.3.7.3.5 Supply, return, and exhaust ventilation system for airborne infections/isolation rooms, protective environment rooms, and critical care areas.
4.3.3.7.3.6 Exhaust fans for laboratory fume hoods, nuclear medicine areas where radioactive material is used.
4.3.3.7.3.7 Ethylene oxide evacuation equipment.
4.3.3.7.3.8 Anesthetic evacuation equipment.
4.3.3.7.3.9 Heating equipment to provide heating for critical care areas.
4.3.3.7.3.10 Heating equipment for all confined patients.
4.3.3.7.3.11 Heating equipment for general patient care areas unless:
4.3.3.7.3.11.1 The outside design temperature is higher than -6.7°C (+20ºF).
4.3.3.7.3.12 One patient elevator providing service to each critical care area.
4.3.3.7.3.13 hyperbaric facilities.
4.3.3.7.3.14 Hypobaric facilities.
4.3.3.7.3.15 Autoclaving equipment.
4.3.3.7.4 The non-essential system may be served by the Emergency Power System Supply during a failure of the normal power source without being considered part of the emergency power system.
4.3.3.7.4.1 These non-essential loads shall transfer onto the Emergency Power System Supply only if the transfer can be done without overloading the Emergency Power System Supply.
4.3.3.7.4.2 These non-essential loads shall be shed if the capacity of the Emergency Power System Supply falls below the capacity required to serve Emergency Power System and non-essential loads.
4.3.3.7.4.3 Non-essential loads may also be served by a separate, dedicated generator(s) and transfer switches, not subject to the requirements of this section.

4.4 Campus distribution systems
4.4.1 Normal Systems
4.4.1.1 Campus distribution feeders
4.4.1.1.1 A Plant may provide feeders to one or more buildings on a campus, even if those buildings are not housing the same types of occupancies.
4.4.1.1.2 Feeders from a Plant to one or more buildings on a campus are NOT considered to be service entrance conductors nor service lateral conductors as defined in NFPA 70, National Electrical Code.
4.4.1.1.3 When a campus feeder serves more than one building, it shall not be necessary to provide overcurrent protection for taps from the campus feeder, so long as the feeder tap is of the same size as the campus feeder.
4.4.1.1.3.1 Where a campus feeder serves more than one building, and where a tap on the feeder is sized to carry at least 75% of the ampacity of the campus feeder, provide one main disconnect switch and overcurrent protection device where the tap feeder enters the building. The six-switch exception in NFPA 70 shall not be permitted for hospital buildings fed by a campus feeder.
4.4.1.1.3.2 Where a campus feeder serves more than one building, and a tap on the feeder is less than 75% of the size of the campus feeder, provide overcurrent protection with ground fault protection at the feeder tap sized to match the ampacity of the tap conductors. The six-switch exception in NFPA 70 shall not be permitted for hospital buildings fed by a campus feeder.
4.4.1.1.4 A building on a campus may obtain power from a campus feeder from a Plant, or from a local utility company.
4.4.2 Essential Systems
4.4.2.1 Plant Building
4.4.2.1.1 Life Safety loads in the plant must be served by one or more transfer switches such that, in the event of a power outage, they will receive power within 10 seconds of the outage. Life Safety loads include:
4.4.2.1.1.1 Illumination of Means of Egress
4.4.2.1.1.2 Exit Signs
4.4.2.1.1.3 Alarm and Alerting Systems
4.4.2.1.1.4 Communication Systems
4.4.2.1.1.5 Control systems
4.4.2.1.1.6 Task lighting and selected receptacles in the generator system location
4.4.2.1.1.7 Generator System Accessories
4.4.2.1.1.8 Task Illumination of all mechanical and electrical spaces in the building
4.4.2.1.1.9 Fire pump
4.4.2.1.1.10 Jockey Pump
4.4.2.1.1.11 Generator accessories, including, but not limited to, the fuel transfer pump, electrically operated louvers, and other generator accessories essential for generator operation.
4.4.2.1.2 Plants do not contain Critical Branch Loads.
4.4.2.1.3 Equipment System loads in the plant must be served by one or more transfer switches such that, in the event of a power outage, they will receive power within sixty seconds of the outage. Equipment System loads include:
4.4.2.1.3.1 Central suction systems serving medical and surgical functions, including controls.
4.4.2.1.3.2 Sump pumps and other equipment required to operate for the safety of major apparatus, including associated control systems and alarms.
4.4.2.1.3.3 Compressed air systems serving medical and surgical functions, including controls.
4.4.2.1.3.4 One patient elevator in the building.
4.4.2.1.3.4 Other selected equipment.
4.4.2.1.4 Non-essential system loads in the plant may be served by the generating equipment so long as either:
4.4.2.1.4.1 The generating system has assumed all Emergency System loads; and
4.4.2.1.4.2 The system has adequate remaining capacity to serve the non-essential loads; and
4.4.2.1.4.3 The non-essential loads will be automatically shed if the generating system becomes overloaded; or.
4.4.2.1.4.4 these loads are served, by a separate set of generating equipment not subject to the requirements of this section.
4.4.2.2 Campus distribution feeders
4.4.2.2.1 A Plant may provide emergency system feeders to one or more buildings on a campus, even if those buildings are not housing the same kinds of occupancies.
4.4.2.2.2 When a campus emergency system feeder serves more than one building, conductors shall be permitted to be tapped, without overcurrent protection at the tap, to supply a transformer and comply with the following conditions (NFPA 70, National Electrical Code):  
4.4.2.2.2.1 The conductors supplying the primary of a transformer have an ampacity at least one-third the rating of the overcurrent device protecting the feeder conductors.
4.4.2.2.2.2 The conductors supplied by the secondary of the transformer shall have an ampacity that is not less than the value of the primary-to-secondary voltage ratio multiplied by one-third of the rating of the overcurrent device protecting the feeder conductors.
4.4.2.2.2.3 The total length of one primary plus one secondary conductor, excluding any portion of the primary conductor that is protected at its ampacity, is not over 7.5 m (25 ft).
4.4.2.2.2.4 The primary and secondary conductors are protected from physical damage by being enclosed in an approved raceway or by other approved means.
4.4.2.2.2.5 The secondary conductors terminate in a single circuit breaker or set of fuses that limit the load current to not more than the conductor ampacity that is permitted by NEC.
A building on a campus may obtain emergency power from a campus emergency feeder from a Plant, or from a local emergency generator.

4.5 Performance and administration

4.5.1 Test Equipment. Test electrical safety test instruments periodically, but not less than annually, for acceptable performance and accuracy. Three years of the test result shall be maintained.

4.5.2 Acceptance Testing

4.5.2.1 Insulation Resistance. The resistance readings of main feeder insulation and main generator feeder insulation shall be taken prior to acceptance.

4.5.2.2 Receptacle Testing in Patient Care Areas.

4.5.2.3 Testing for hospital grade receptacles required at patient bed locations and in anesthetizing locations shall be performed after initial installation, replacement, or servicing of the device.

4.5.2.3.1 Voltage Measurements.

4.5.2.3.1.1 Voltage limit shall be 20 mV.

4.5.2.3.1.2 The voltage measurements shall be made under no-fault conditions between a reference point and exposed fixed electrical equipment with conductive surfaces in a patient care vicinity. The voltage measurements shall be made with an accuracy of ±20 percent. Voltage measurements for faceplates of wiring devices shall not be required.

4.5.2.3.1.3 Voltage measurements specified in this item shall be made with an instrument having an input resistance of 1000 ohms ±10 percent at frequencies of 1000 Hz or less.

4.5.2.3.1.4 The voltage across the terminals (or between any terminal and ground) of resistance-measuring instruments used in occupied patient care areas shall not exceed 500 mV rms or 1.4 dc or peak to peak.

4.5.2.3.2 Impedance Measurements.

4.5.2.3.2.1 Impedance limit shall be 0.2 ohms for quiet ground systems, and 0.1 ohms for all others.

4.5.2.3.2.2 The impedance measurement shall be made with an accuracy of ±20 percent. For new construction, the impedance measurement shall be made between the reference point and the grounding contact of 10 percent of all receptacles in each patient care vicinity. The impedance measurement shall be the ratio of voltage developed (either 60 Hz or dc) between the point under test and the reference point to the current applied between these two points.

4.5.2.3.3 Receptacle Testing

4.5.2.3.3.1 Confirm the physical integrity of each receptacle by visual inspection.

4.5.2.3.3.2 Verify the continuity of the grounding circuit in each electrical receptacle.

4.5.2.3.3.3 Confirm the correct polarity of the hot and neutral connections in each electrical receptacle.

4.5.2.3.3.4 The retention force of the grounding blade of each electrical receptacle (except locking-type receptacles) shall be not less than 115 g (4 oz).

4.5.2.3.4 Additional testing of receptacles in patient care areas shall be performed at intervals defined by documented performance data. Performance data shall be updated every five year.

4.5.2.4 Grounding System Testing in Patient Care Areas

4.5.2.4.1 For new construction, the effectiveness of the grounding system shall be evaluated before acceptance.

4.5.2.4.2 Small, wall-mounted conductive surfaces, not likely to become energized, such as surface-mounted towel and soap dispensers, mirrors, and so forth, shall not be required to be intentionally grounded or tested.

4.5.2.4.3 Large, metal conductive surfaces not likely to become energized, such as windows, door frames, and drains, shall not be required to be intentionally grounded or periodically tested.

4.5.2.4.4 Whenever the electrical system has been altered or replaced, that portion of the system shall be tested.
4.5.2.4.5 Reference Point. The voltage and impedance measurements shall be taken with respect to a reference point. The reference point shall be one of the following:

4.5.2.4.5.1 A reference grounding point.
4.5.2.4.5.2 A grounding point, in or near the room under test, that is electrically remote from receptacles, for example, and all-metal cold-water pipe.
4.5.2.4.5.3 The grounding contact of a receptacle that is powered from a different branch circuit from the receptacle under test

4.5.2.5 Isolated Power System (Where Installed).

4.5.2.5.1 A permanent record shall be kept of the results of each of the tests for three years.
4.5.2.5.2 The impedance (capacitive and resistive) to ground of either conductor of an isolated system shall exceed 200,000 ohms when installed. The installation at this point shall include receptacles but is not required to include lighting fixtures or components of fixtures. This value shall be determined by energizing the system and connecting a low-impedance ac milliammeter (0 mA to 1 mA scale) between the reference grounding point and either conductor in sequence. This test shall be permitted to be performed with the line isolation monitor connected, provided the connection between the line isolation monitor and the reference grounding point is open at the time of the test. After the test is made, the milliammeter shall be removed and the grounding connection of the line isolation monitor shall be restored. When the installation is completed, including permanently connected fixtures, the reading of the meter on the line isolation monitor, which corresponds to the unloaded line condition, shall be made. This meter reading shall be recorded as a reference for subsequent line-impedance evaluation. This test shall be conducted with no phase conductors grounded.
4.5.2.5.3 After any repair or renovation to an electrical distribution system supporting the LIM, the LIM circuit shall be tested in accordance with OEM standards.

4.5.2.6 Line Isolation Monitor Tests.

4.5.2.6.1 Test the Line Isolation Monitor (LIM) circuit after installation, and prior to being placed in service, by successively grounding each line of the energized distribution system through a resistor of 200.V ohms, where V equals measured line voltage. The visual and audible alarms shall be activated. Or by commissioning by a factory authorized representative

4.5.2.7 Ground Fault protection Testing: When equipment ground-fault protection is first installed, each level shall be performance-tested to ensure compliance with OEM standards.

4.5.2.8 Emergency Power Supply System (EPSS): Installation acceptance and testing of the EPSS shall be in accordance with Section 7.13 of NFPA 110, Standard for Emergency and Standby Power Systems.

4.5.3 Maintenance and Testing of Electrical System.

4.5.3.1 Receptacles: Inspect the receptacles in patient bed locations at intervals not less than 12 months.
4.5.3.2 Circuit Breakers. Main circuit breaker, emergency generator breaker, and feeder circuit breakers up to and including 2 levels of ground fault protection downstream from the service or feeder disconnecting means shall be inspected annually and a program for periodically exercising the components shall be established according to manufacturer’s recommendations. All main and feeder breakers will be operated at an interval not to exceed 3 years and documented as to being tested.
4.5.3.3 Insulation Resistance. The resistance readings of main feeder insulation shall be taken whenever damage is suspected.
4.5.3.4 Isolated Power Systems: LIM panels shall be tested at intervals of not more than 1 month by actuating the LIM test switch. For a LIM circuit with automated self-test and self-calibration capabilities, this test shall be performed at intervals of not more than 12 months. Actuation of the test switch shall activate both visual and audible alarm indicators.
4.5.3.5 Maintenance of Emergency Power System Supply. The generator set or other Emergency Power System Supply and associated equipment, shall be so maintained as to be
capable of supplying service within the shortest time practicable within the requirements stated above.

4.5.3.5.1 Maintain the EPSS in accordance with NFPA 110, *Standard for Emergency and Standby Power Systems.*

4.5.3.5.2 Inspection and Testing.
4.5.3.5.3 Generator sets shall be tested 12 times a year with testing intervals between not less than 20 days or exceeding 40 days. Perform the required testing during regular hours of operation and not at night or on weekends.
4.5.3.5.4 Test EPSS’s serving essential systems in accordance with NFPA 110, *Standard for Emergency and Standby Power Systems.*
4.5.3.5.5 The scheduled test under load conditions shall include a complete simulated cold start and appropriate automatic and manual transfer of all essential electrical system loads. This does not require a black start of the system. All hospital systems will be black started at an interval not to exceed 12 months.

4.5.3.5.6 Maintenance of Batteries. Batteries for on-site generators shall be maintained in accordance with NFPA 110, *Standard for Emergency and Standby Power Systems.*

4.5.3.5.7 Test Personnel. The scheduled tests shall be conducted by qualified personnel as defined in NFPA 70.

4.5.3.6 Recordkeeping.
4.5.3.6.1 General. A record shall be maintained of the tests required by this chapter and associated repairs or modification.
4.5.3.6.2 At a minimum record keeping will consist of a set interval for testing of each area. Records may be computerized but paper records are acceptable. Testing of areas as an example would be as follows:
4.5.3.6.3 Area electrical inspections: (This would equate to electrical safety inspections of equipment and systems)
4.5.3.6.4 Inspection should not exceed 12-month intervals unless performance data shows a reasonable expectation to move the time period out.
4.5.3.6.5 Example of performance data:

<table>
<thead>
<tr>
<th>Date tested</th>
<th>Room or area tested</th>
<th>Test criteria</th>
<th>Person doing test</th>
<th>Number of items tested</th>
<th>Number of failures; Percentage of passage to failures</th>
<th>Data showing corrections – date – what was done – who corrected – date – what was done – who corrected</th>
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<tr>
<td>4.5.3.6.5.1</td>
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4.5.3.6.6 Lim panels – Monthly test:

<table>
<thead>
<tr>
<th>Date tested</th>
<th>Monthly test</th>
<th>Criteria of test – visuals – alarms etc.</th>
<th>Person doing test</th>
<th>Number of items tested</th>
<th>Number of failures; Percentage of passage to failures</th>
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</thead>
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<tr>
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4.5.3.6.7 Ground Fault receptacles and breakers:

<table>
<thead>
<tr>
<th>Date tested</th>
<th>Criteria of test – visuals – alarms etc.</th>
<th>Person doing test</th>
<th>Number of items tested</th>
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</table>
4.5.3.6.7.5 Number of failures
4.5.3.6.7.6 Percentage of passage to failures

Annexes
A.4.2.1.1.3 Consideration should be given to providing labels at each wiring device not in rooms used for delivering patient care, indicating the identity of the distribution panel serving that power outlet or equipment, especially where the location or identity might not be readily apparent.
A.4.2.2.5 The requirement for grounding interconnection between the normal and essential power systems follows the principle of minimizing possible potential differences between the grounding pins of receptacles in one area by bringing the grounding conductors to a common point.
A.4.2.3.2 Within the constraints of the equipment provided, consideration should be given to coordinating circuit breakers, fuses, and other overcurrent protective devices so that power interruption in that part of the circuit that precedes the interrupting device closest to a fault is not likely to occur.
A.4.2.4.3 Listed Class A ground-fault circuit interrupters trip when a fault current to ground is 6mA or more.
A.4.2.1.1.1.1 It is best, if possible, to employ only one type of receptacle (standard three-prong type) for as many receptacles being served by the same line voltage to avoid the inability to connect life-support equipment in emergencies. The straight-blade, three-prong receptacle is now permitted in all locations in a hospital. Previously, special receptacles were specified in operating room locations and have caused compatibility problems.
A.4.2.5.2 Patient protection is provided primarily by an adequate grounding system. The ungrounded secondary of the isolation transformer reduces the cross-sectional area of grounding conductors necessary to protect the patient against voltage resulting from fault current by reducing the maximum current in case of a single probable fault in the grounding system. The line isolation monitor is used to provide warning when a single fault occurs. Excessive current in the grounding conductors will not result in a hazard to the patient unless a second fault occurs. If the current in the grounding system does not exceed 10 mA, even under fault conditions, the voltage across 9.84 ft (3 m) of No. 12 AWG wire will not exceed 0.2 mV, and the voltage across 9.84 ft (3 m) of No. 18 AWG grounding conductor in a flexible cord will not exceed 0.8 mV. Allowing 0.1 mV across each connector, the voltage between two pieces of patient-connected equipment will not exceed 2 mV.
A.4.2.5.2.1 It is desirable to limit the size of the isolation transformer to 10 kVA or less and to use conductor insulation with low leakage to meet the impedance requirements. Keeping branch circuits short and using insulation with a dielectric constant less than 3.5 and insulation resistance constant greater than 6100 megohmmeters (20,000 megohm-ft) at 60°F (16°C) reduces leakage from line to ground.
To correct milliammeter reading to line impedance use the following equation:

\[ V = \frac{I}{X} \]

where:
\( V \) = isolated power system voltage
\( I \) = milliammeter reading made during impedance test
A.4.2.5.5 The line isolation monitor can be a composite unit, with a sensing section cabled to a separate display panel section, on which the alarm and test functions are located, if the two sections are within the same electric enclosure.
A.4.3.2.10.1 For a campus, consider providing campus annunciation system, consisting of a centralized operations center. If the campus has a Plant Building, the operations center may be in the Plant Building. The following should be there:
Line impedance in ohms = \( \frac{V \times 100}{I} \)
Fire alarm annunciation and controls for the campus.
Building automation annunciation and controls for the campus.
Ability to initiate overhead paging to any building on the campus.
Position indicators for all automatic transfer switches in the campus.
Annunciators for all generators on the campus.

A.4.2.2 In a conventional grounded power distribution system, one of the line conductors is deliberately grounded, usually at some distribution panel or the service entrance. This grounded conductor is identified as the neutral conductor. The other line conductor (or conductors) is (are) the high side of the line. The loads to be served by this distribution system are fed by the high and neutral conductors.

In addition to the high and neutral conductors, a grounding conductor is provided. One end is connected to the neutral at the point where the neutral is grounded, and the other end leads out to the connected loads. For purposes here, the load connection point will be considered to be a convenience receptacle, with the grounding conductor terminating at the grounding terminal of that receptacle.

This grounding conductor can be a separate wire running from the receptacle back to the remote grounding connection (where it joins the neutral conductor). If that separate conductor does not make any intermediate ground contacts between the receptacle and the remote ground, then the impedance of the connection between the receptacle and the remote ground is primarily the resistance of the grounding conductor itself and is, therefore, predictable.

If, however, the receptacle is also interconnected with the remote ground point by metallic conduit or other metallic building structures, the impedance of the circuit between receptacle and remote ground is not easily predictable, nor is it easy to measure accurately, although one can be sure that the impedance will be less than that of the grounding wire itself because of the additional parallel paths.

Fortunately, as will become apparent in the following paragraphs, the absolute value of the apparent impedance between the grounding contact of an outlet and the remote ground point need not be known or measured with great accuracy.

Ideally, and under no-fault conditions, the grounding system described earlier is supposed to be carrying no current at all. If that were true, then no voltage differences would be found between exposed conductive surfaces of any electrical appliances that were grounded to the grounding contacts of the receptacles that powered them. Similarly, there would be no voltage differences between these appliances and any other exposed metal surface that was also interconnected with the grounding system, provided that no currents were flowing in that interconnection.

Ideal conditions, however, do not prevail, and even when there are no “faults” within an appliance, residual “leakage” current does flow in the grounding conductor of each of the appliances, producing a voltage difference between the chassis of that appliance and the grounding contact of the receptacle that feeds it. Furthermore, this current can produce voltage differences among other appliances plugged into various receptacles on the system.

Fortunately, these leakage currents are small, and for reasonably low grounding-circuit impedances, the resulting voltage differences are entirely negligible.

If, however, a breakdown of insulation between the high side of the line and the chassis of an appliance should occur, the leakage condition becomes a fault condition, the magnitude of which is limited by the nature of the breakdown or, in the case of a dead short circuit in the appliance, the magnitude of the fault current is limited only by the residual resistance of the appliance power cord conductors and that of the power distribution system.

In the event of such a short circuit, the impedance of the grounding circuit, as measured between the grounding contact of the receptacle that feeds the defective appliance and the remote ground point where the neutral and grounding conductors are joined, should be so small that a
large enough fault current will flow to ensure a rapid breaking of the circuit by the overcurrent protective device that serves that receptacle.

For a 20-A branch circuit, a fault current of 40 or more amperes would be required to ensure a rapid opening of the branch-circuit overcurrent-protective device. This corresponds to a circuit impedance of 3 ohms or less, of which the grounding system should contribute 1 ohm or less.

During the time this large fault current flows in the grounding system, the chassis of the defective appliance is raised many volts above other grounded surfaces in the same vicinity. The hazard represented by this condition is minimized by the fact that it exists for only a short time, and unless a patient simultaneously contacts both the defective appliance and some other grounded surface during this short time interval, there is no hazard. Furthermore, the magnitude of an applied voltage required to produce a serious shock hazard increases as its duration decreases, so the rapidity with which the circuit is interrupted helps reduce shock hazard even if such a patient contact should occur.

If, however, the defect in the appliance is not such as to cause an immediate circuit interruption, then the effect of this intermediate level of fault current on the voltages appearing on various exposed conductive surfaces in the patient care vicinity should be considered.

Because all of this fault current flows in the grounding conductor of the defective appliance’s power cord, the first effect is to raise the potential of this appliance above that of the receptacle that feeds it by an amount proportional to the power cord grounding conductor resistance. This resistance is required to be less than 0.15 ohm, so fault currents of 20 A or less, which will not trip the branch-circuit overcurrent-protective device, will raise the potential of the defective appliance above the grounding contact of its supply receptacle by only 3 V or less. This value is not hazardous for casual contacts.

The fault current that enters the grounding system at the grounding contact of any receptacle in the patient care vicinity could affect the potential at the grounding contacts of all the other receptacles, and, more importantly, it could produce significant voltage differences between them and other grounded surfaces, such as exposed piping and building structures.

If one grounded point is picked as a reference (a plumbing fixture in or near the patient care vicinity, for example), and then the voltage difference is measured between that reference and the grounding contact of a receptacle, produced by driving some known current into that contact, a direct measure of the effectiveness of the grounding system within the patient care vicinity is obtained. The “figure of merit” can be stated as so many volts per ampere of fault current. The ratio volts per ampere is, of course, impedance; but because the exact path taken by the fault current is not known, and because the way in which the reference point is interconnected with the grounding system is not known, it cannot be stated that this value is the impedance between the receptacle and some specific point, such as the joining of the neutral and grounding conductors. But it can be stated that this measured value of “effective impedance” is indicative of the effectiveness with which the grounding system minimizes voltage differences between supposedly grounded objects in the patient care vicinity that are produced by ground faults in appliances used in that vicinity. This impedance, which characterizes the ability of the grounding system to maintain nearly equipotential conditions within the patient care vicinity, is of prime importance in assessing shock hazard; but this impedance is not necessarily the same as the impedance between receptacle and remote ground point, which controls the magnitude of the short-circuit current involved in tripping the branch-circuit overcurrent-protective device.

Fault currents on the grounding system can also come from neutral-to-ground faults, which permit some current to flow in the neutral and some in the ground. This type of fault is often the cause of interference on EEG and ECG equipment. It is often not recognized easily because, except for 60-Hz interference, the equipment works perfectly properly. It is most easily found by causing a substantial change in the line-to-line load and noting changes in the ground-to-reference voltage.
A.4.5.2.3 The grounding system (reference ground and conduit) is to be tested as an integral system. Lifting of grounds from receptacles and fixed equipment is not required or recommended for the performance of this test.

A.4.5.2.3.1 Effective grounding to safely handle both fault and leakage currents requires following the requirements of both Chapter 4 of NFPA 99 and Article 250 of NFPA 70, National Electrical Code, having good workmanship, and using some techniques that are not in these documents.

The performance of the grounding system is made effective through the existence of the green grounding wire, the metal raceway, and all of the other building metal. Measurements have shown that it is the metal raceway and building steel that provide most of the effective grounding path at the receptacle, including plug-to-receptacle impedance. The green grounding wire becomes a backup, not a primary grounding path performer.

Good practice calls for each receptacle to have a good jumper grounding connection to the metal raceway at the receptacle location in addition to having the green grounding wire connecting these points to the grounding bus in the distribution panel. Good workmanship includes seeing that these grounding connections are tight at each receptacle and that all metal raceway joints are secure and tight.

The voltage difference measurements listed connection with power distribution grounding systems should ideally be made with an oscilloscope or spectrum analyzer in order to observe and measure components of leakage current and voltage differences at all frequencies.

For routine testing, such instruments could be inconvenient. An alternative is to use a metering system that weighs the contribution to the meter reading of the various components of the signal being measured in accordance with their probable physiological effect.

A.4.5.2.3.2 It is not the intent that each receptacle be tested. It is intended that compliance be demonstrated through random testing. The 10 percent random testing should include a mixture of both normal and emergency receptacles.

A.4.5.2.3.4 Although several approaches to documentation exist in hospitals, the minimum acceptable documentation should convey what was tested, when it was tested, and whether it performed successfully. Adopting a system of exception reporting can be the most efficient form of recordkeeping for routine rechecks of equipment or systems and thereby minimize technicians' time in recording the value of each measurement taken. For example, once a test protocol is established, which simply means testing the equipment or system consistent with Chapter 4, the only item (value) that needs to be recorded is what failure or what deviation from the requirements of the chapter was detected when a corrective action (repair) was undertaken. This approach can serve to eliminate, for example, the need to keep individual room sheets to record measured results on each receptacle or to record measurement values of all types of leakage current tests.

A.4.5.2.3.4 Connection to Dual Source of Normal Power. For the greatest assurance of continuity of electrical service, the normal source should consist of two separate full-capacity services, each independent of the other. Such services should be selected and installed with full recognition of local hazards of interruption, such as icing and flooding.

Where more than one full-capacity service is installed, they should be connected in such a manner that one will pick up the load automatically upon loss of the other, and so arranged that the load of the emergency and equipment systems will be transferred to the alternate source (generator set) only when both utility services are deenergized, unless this arrangement is impractical and waived by the authority having jurisdiction. Such services should be interlocked in such a manner as to prevent paralleling of utility services on either primary or secondary voltage levels.
Note that in any installation where it is possible to parallel utility supply circuits, for example, to prevent interruption of service when switching from one utility source to another, it is imperative to consult the power companies affected as to problems of synchronization.

Facilities whose normal source of power is supplied by two or more separate central-station-fed services (dual sources of normal power) experience greater reliability than those with only a single feed.

A.4.3.2.2 Careful consideration should be given to the location of the spaces housing the components of the essential electrical system to minimize interruptions caused by forces common to the area (e.g., storms, floods, or earthquakes, or hazards created by adjoining structures or activities), or potential internal hazards such as pipes bursting. Consideration should also be given to the possible interruption of normal electrical services resulting from similar causes as well as possible disruption of normal electrical service due to internal wiring and equipment failures.

Consideration should be given to the physical separation of the main feeders of the essential electrical system from the normal wiring of the facility to prevent possible simultaneous destruction as a result of a local catastrophe.

In selecting electrical distribution arrangements and components for the essential electrical system, high priority should be given to achieving maximum continuity of the electrical supply to the load. Higher consideration should be given to achieving maximum reliability of the Emergency Power Supply and its feeders rather than protection of such equipment, provided the protection is not required to prevent a greater threat to human life such as fire, explosion, electrocution, and so forth, than would be caused by the lack of essential electrical supply.

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 is on opposite walls, both to the outdoors. [110: A.7.7.1]

A.4.3.2.10 As a supplement to hard-wired alarm annunciations, it is permissible to have Level 1 and Level 2 EPS and ATS functions monitored offsite. Monitoring stations can include pagers, cell phones, and internet or intranet connected devices. 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. [110: A.6.2.2.1]

A.4.3. For critical system loads, consider adding sources of redundancy such as UPS.
A.4.3.3 Providing more, smaller transfer switches closer to loads provides higher levels of reliability (fewer single points of failure) than providing fewer, larger transfer switches closer to the sources. Where reliability of service is especially important due to loads being served, consider the more reliable distribution design.
A.4.3.6.5 Consider providing closed transition transfer switches with bypass isolation and UPS for especially sensitive areas of a hospital in order to make transfer switch testing less disruptive.
A.4.3.7.3.2 The equipment can be arranged for sequential delayed-automatic connection to the Emergency Power Supply to prevent overloading the generator where engineering studies indicate that it is necessary.
A.4.3.7.3.12 In instances where interruption of normal power would result in other elevators stopping between floors, throw-over facilities shall be provided to allow the temporary operation of any elevator for the release of patients or other persons who are confined between floors.
A.4.3.7.3.11.1 The outside design temperature is based on the 97.6 percent design value as shown in Chapter 24 of the ASHRAE Handbook of Fundamentals.
A.4.3.3.7.4 Consideration should be given to selected equipment in kitchens, laundries, and radiology rooms and to selected central refrigeration.
A.4.3.3.3 It is desirable that, where heavy interruption currents can be anticipated, the transfer load be reduced by the use of multiple transfer devices. Elevator feeders, for instance, might be less hazardous to electrical continuity if they are fed through an individual transfer device.
A.4.2.1.1.4 The same color should be used throughout the facility. It is recommended that the receptacle itself is colored (typically red is used in healthcare facilities), not just the cover. Covers tend to be swapped out during painting.
A.4.5.3.2 Main and feeder circuit breakers should be periodically tested under simulated overload trip conditions to ensure reliability.
C.4 Additional Information on Chapter 4.
C.4.1 Typical Hospital Wiring Arrangement. See Figure C.4.1. Separate transfer switches for each branch, as shown, are required only if dictated by load considerations. Smaller facilities can be served by a single transfer switch.

***Insert Figure Here***

**FIGURE C.4.1 Typical Hospital Wiring Arrangement.**

C.4.2 Suggested Format for Listing Functions to Be Served by the Essential Electrical System in a Hospital. It may be advantageous, in listing the specific functions for a given construction project or building review, to list them, at the outset, by geographical location within the project, in order to ensure comprehensive coverage. Every room or space should be reviewed for possible inclusion of the following:
(1) Lighting (partial or all)
(2) Receptacles (some or all)
(3) Permanently wired electrical apparatus

The format suggested herein is offered as a convenient tool, not only for identifying all functions to be served and their respective time intervals for being reenergized by the alternate electric source, but also for documenting other functions that were considered, discussed, and excluded as nonessential. This last column is considered worthy of attention. (See Figure C.4.32.) It may be that the hospital engineer or the reviewing authority will wish to keep on file a final copy of the list, which would be the basis for the electrical engineer’s detailed engineering design. Although this suggested format is intended for use by a hospital it may, with suitable changes, be useful for other health care facilities.

***Insert Figure Here***

**FIGURE C.4.2 Essential Electrical Systems.**
FIGURE C.A.1 Typical Hospital Wiring Arrangement.

Essential Electrical Systems

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<th>Hospital</th>
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<tr>
<th>Room no.</th>
<th>Room name</th>
<th>Function served</th>
<th>Life safety branch</th>
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* Indicate precise lighting, receptacles, and/or equipment. Use a separate line for each function.

** Indicate time interval.

FIGURE C.A.2 Essential Electrical Systems.

99-78  Log #CP318  HEA-ELS  
(4.1.1, 4.1.2)  
Final Action: Accept

Submitter: Technical Committee on Electrical Systems,  
Recommendation: Add new 4.1.1 and 4.1.2 as follows:  
4.1.1 This chapter shall apply to all health care facilities, as specified in section 1.3.  
4.1.2 The following sections of this chapter shall apply to new and existing health care facilities:  
4.3.2.2.2.3, 4.3.2.2.4.2, 4.3.2.2.6.1, 4.3.2.2.6.2(F), 4.3.2.2.8.3(B)(2)(3)(4), 4.3.4, 4.4.1.1.17.5, 4.4.2.2.4.2(B),  
4.4.2.2.4.3, 4.4.4, 4.5.4, 4.6.2.2.3.2, 4.6.3.1, 4.6.4

Substantiation: This distinguishes the sections that apply to new and existing facilities.  
Committee Meeting Action: Accept  
Committee Statement: Section 4.3.2.2.6.2(F), is a new section from Committee Proposal 99-90 (Log #CP314) and does not exist in the 2005 edition. This is added to the list in section 4.1.2.  
Section 4.4.1.1.17.5, is a new section from Proposal 99-106 (Log #85) and does not exist in the 2005 edition. This is added to the list in section 4.1.2.  
See sections 6.1.1 and 6.1.2 in the preprint.

99-79  Log #CP323  HEA-ELS  
(4.3.2.1.1 (New))  
Final Action: Accept

Submitter: Technical Committee on Electrical Systems,  
Recommendation: Add new paragraph as follows:  
4.3.2.1.1 Distribution system arrangements shall be designed to minimize interruptions to the electrical systems due to internal failures by the use of adequately rated equipment.

Substantiation: This is consistent with 4.4.1.1.1.1 and for coordination.  
Committee Meeting Action: Accept  
Committee Statement: See section 6.3.2.1.1 in the preprint.

99-80  Log #386  HEA-ELS  
(4.3.2.2.1.1)  
Final Action: Reject

Submitter: Jan Ehrenwerth, Yale University School of Medicine  
Recommendation: Add new text as follows:  
Circuits. Circuit breaker panels should be located inside the operating room, and not in the corridor.  
Substantiation: Having the circuit breaker panel in the operating room is a marked advantage whenever there is an electrical problem with anesthesia or operating room equipment. Trying to identify the proper panel for a particular operating room when it is located in a hallway is very difficult task. This is especially true if there is an urgent or emergent problem. Also, if the operating room has isolated power or ground fault circuit interrupters, having the panel in the room is essential to identifying the faulty piece of equipment.  
Committee Meeting Action: Reject  
Committee Statement: Requiring the hospital engineering staff to enter the operating room to reset or replace an overcurrent protection device presents logistical problems while cases are being conducted in the operating room. Locating the electrical distribution equipment in the operating room has potential ramifications relative to NFPA 70E requirements for worker safety.

Printed on 3/2/2010
Technical Committee on Electrical Systems,

**Recommendation:**
4.3.2.2.1.2 Critical Care Areas. These rooms shall be served by circuits from critical branch panel(s) served from a single automatic transfer switch and a minimum of one circuit served by the normal power distribution system or by a system originating from a second critical branch automatic transfer switch.

**Substantiation:** Clarifies that this transfer switch is an automatic transfer switch.

**Committee Meeting Action:** Accept

**Committee Statement:** See section 6.3.2.2.1.2 in the preprint.

---

Technical Committee on Electrical Systems,

**Recommendation:** Add a new section to read as follows and renumber existing:

4.3.2.2.1.3 Access to Overcurrent Protective Devices.

(A) Only authorized personnel shall have access to overcurrent protective devices serving Category 1 and Category 2 rooms.

(B) Overcurrent protective devices serving Category 1 and Category 2 rooms shall not be permitted to be located in public access spaces.

(C) Where used, such as in critical care areas, isolated power panels shall be permitted in those locations.

**Substantiation:** Many designers locate electrical panels in public corridors where they are accessible to the general public, creating a patient safety issue due to unauthorized access to overcurrent devices, and in addition, a safety issue exists when electrical equipment in hallways is being serviced and NFPA 70E boundaries have to be followed.

**Committee Meeting Action:** Accept

**Committee Statement:** See section 6.3.2.2.1.3 in the preprint.

---

Technical Committee on Electrical Systems,

**Recommendation:** 4.3.2.2.2.3 Separate Grounding Conductor. When existing construction does not have a separate grounding conductor, the continued use of the system shall be permitted, provided it meets the performance requirements in 4.3.3.1 and is verified annually.

**Substantiation:** It is important to validate the integrity of an antiquated and substandard grounding system.

**Committee Meeting Action:** Accept

**Committee Statement:** See section 6.3.2.2.2.3 in the preprint.
99-84  Log #47 HEA-ELS  (4.3.2.2.4.1 and 4.3.2.2.4.2)

Final Action: Accept in Principle

Submitter: Burton R. Klein, Burton Klein Associates

Recommendation:  1. In 4.3.2.2.4.1, add title to read: "Ground-Fault Protection."
  2. In 4.3.2.2.4.2, add title to read: "Ground-Fault Circuit Interruption."

Substantiation:  Editorial. Identify the two different types of circuit protection being required: one for equipment protection, the other for personnel protection.

Committee Meeting Action:  Accept in Principle

Committee Statement:  See the Committee Action/Statement on Proposal 99-86 (Log #57).

99-85  Log #55 HEA-ELS  (4.3.2.2.4.1 and 4.3.2.2.4.2)

Final Action: Accept in Principle

Submitter: Burton R. Klein, Burton Klein Associates

Recommendation:  1. In 4.3.2.2.4.1 add title to read: "Ground-fault Protection."
  2. In 4.3.2.2.4.2, add title to read: "Ground-fault Circuit Interruption."

Substantiation:  Editorial. Identify the two different types of circuit protection being required: one for equipment protection, the other for personnel protection.

Committee Meeting Action:  Accept in Principle

Committee Statement:  See the Committee Action/Statement on Proposal 99-86 (Log #57).

99-86  Log #57 HEA-ELS  (4.3.2.2.4.2)

Final Action: Accept in Principle

Submitter: Burton R. Klein, Burton Klein Associates

Recommendation:  Move text to make it new paragraph 4.3.2.2.6, adding title "Personnel Protection". Paragraph should read:
  "4.3.2.2.6 Personnel Protection. If used, ground-fault circuit interrupters (GFCIs) shall be listed and approved for the purpose."

Substantiation:  GFCIs are for protecting people from electric shocks (since they trip at 6 ma). GFCIs are not installed for circuit protection which is the title of 4.3.2.2.4.

Committee Meeting Action:  Accept in Principle

Committee Statement:  The committee action revises the title of the entire section to clearly reflect what the two requirements cover. The two titles for the subdivisions differentiate between the two types of ground-fault protection required. These changes are editorial in nature and do not change the technical content of this section.

See sections 6.3.2.2.4
99-87  Log #75  HEA-ELS  
(4.3.2.2.4.2)  
Final Action: Accept

Submitter: Burton R. Klein, Burton Klein Associates

Recommendation: Revise 4.3.2.2.4.2 to read as follows:
If used, ground-fault circuit interrupters (GFCIs) shall be listed and approved for the purpose.

Substantiation: Wording deleted is not necessary as listed devices include the purpose for which they are listed.

Committee Meeting Action: Accept
Committee Statement: See section 6.3.2.2.4.2 of the preprint.

99-88  Log #397  HEA-ELS  
(4.3.2.2.4.3)  
Final Action: Reject

Submitter: Chad Kennedy, Schneider Electric/Square D

Recommendation: Add new text to read as follows:
4.3.2.2.4.3 The EES shall be protected by appropriately rated Surge-Protective Devices and installed in accordance with NFPA 70. The surge-protective devices shall be installed for both the normal and alternate EES sources ahead of or at the transfer switch equipment.

Substantiation: In order to provide continuity of both quality and availability of power, the EES should have surge-protective devices installed to provide basic electrical insulation system and equipment protection from surge events. Transient overvoltage events can be caused by lightning poor system grounding methods, power factor correction capacitor switching and the temporary neutral loss during 4-pole transfer operation. Surge-protective devices appropriately sized and rated are an effective means of mitigating such common transients which potentially impact the EES reliability. This requirement is consistent with the Critical Operations Power Systems requirements found in NFPA 70, Article 708.

Committee Meeting Action: Reject
Committee Statement: Use of surge-protective devices should be a design consideration and not mandated by this standard. The recommended text does not specify the levels of surge-protective devices required in the EES.
4.3.2.6.2(D) Receptacles for Special Area. Receptacles shall not be required in areas where medical requirements mandate otherwise (e.g., certain psychiatric, pediatric, or hydrotherapy areas). Receptacles located within the rooms, bathrooms, playrooms, activity rooms, and patient care areas of pediatric wards shall be listed Tamper Resistant or shall be of the Shock Fault Circuit interrupted (SFCI) type.

Substantiation: U.S. Consumer Product Safety Commission (CPSC) conducted a 10 year study (1991 - 2001) of National Electronic Injury Surveillance Systems (NEISS). The data shows 24,000+ children under 10 years old were treated in Emergency Rooms for incidents related to electrical receptacles. A similar study done by Canadian Hospitals Injury Reporting and Prevention Program (CHIRPP) 8 Year Study (1996-2003) from 14 CHIRPP Hospitals, 465 children under 9 years old were treated in Emergency Rooms for incidents related to electrical receptacles. The National Electrical Code, NFPA 70 2005-2008, has added requirements for tamper resistant receptacles in dwellings and Health Care pediatric areas.

GFCI outlets and breakers are designed and tested to prevent death for most adults from line to ground leakage, but do not protect against death from line to neutral contact. Young adults and children have a lower resistance to electrical current affects and are more vulnerable to injury.

Protection from line-to-neutral shocks is needed around children, since they do not all recognize the shock hazards and risks. Tamper Resistance outlets use a mechanical insulating shutter system to shield children from accessing live voltages on electrical receptacle sockets. Shock Fault Circuit Interrupters (SFCI) uses a relay to normally disconnect electricity at the receptacle sockets. SFCI only turns electricity on at the socket when it detects the insertion of an electrical plug. The detection mechanism is an RFID tag embedded in a device plug or attached to the face of a device plug that complies with the RightPlug standard. Both Tamper Resistance and SFCI outlets provide a reasonable means of preventing line-to-neutral shocks.

Tamper Resistance Receptacles are not tamperproof. These receptacles provide a reasonable means of protection against shock but are not child or foolproof. In my area of Wisconsin, some of the Health Care Facilities that house children go as far as disconnecting all the power to receptacle outlets in pediatric areas.

Adding this requirement to NFPA 99 will improve the safety of persons from the affects of electricity.

This is not original material; its reference/source is as follows:
NFPA 70 NEC 2005 & 2008; NEMA; CPSC & CHIRPP Data; OFI Inc.; and SFCI information
Committee Meeting Action: Reject
Committee Statement: Shock fault circuit interrupters has no listing requirements. There is no evidence of a problem and unproven technology.
Technical Committee on Electrical Systems,

Revise section 4.3.2.2.6.2 to read as follows:

4.3.2.2.6.2 Minimum Number of Receptacles. The number of receptacles shall be determined by the intended use of the patient care rooms in accordance with 4.3.2.2.6.2(A) through 4.3.2.2.6.2(E).

(A) Receptacles for Patient Bed Locations in General Care Areas (Category 2). Each patient bed location shall be provided with a minimum of eight receptacles.

(B) Receptacles for Patient Bed Locations in Critical Care Areas (Category 1). Each patient bed location shall be provided with a minimum of fourteen receptacles.

(C) Receptacles for Operating Rooms (Category 1). Operating rooms shall be provided with a minimum of thirty-six receptacles.

(D) Receptacles for Bathrooms or Toilets. Receptacles shall not be required in bathrooms or toilet rooms.

(E) Receptacles for Special Rooms. Receptacles shall not be required in rooms where medical requirements mandate otherwise (e.g., certain psychiatric, pediatric, or hydrotherapy rooms).

(F) Designated General Care Pediatric Locations. Receptacles that are located within the patient rooms, bathrooms, playrooms, and activity rooms of pediatric units, other than nurseries, shall be listed tamper-resistant or shall employ a listed tamper-resistant cover.

Substantiation: The vast expansion of electrically powered equipment in critical care areas and in operating rooms demands that the minimum number of electrical receptacles be increased. Modern operating rooms have an array of line powered equipment including monitors, anesthesia machines, patient warmers, fluid warmers, electrocautery, x-ray, and microscopes. The amount of line powered equipment is constantly increasing. Modern health care facilities demand more receptacles at the bedside due to increased use of equipment.

Committee Meeting Action: Accept
Committee Statement: This can be found in section 6.3.2.2.6.2 in the preprint.

Jan Ehrenwerth, Yale University School of Medicine

Revise text to read as follows:

Minimum Number of Receptacles. (B) Receptacles for Patient Bed Locations in Critical Care Areas. Each patient bed location shall be provided with a minimum of eighteen receptacles (or three nine duplex receptacles). Anesthetizing locations, where surgery is performed shall be provided with a minimum of thirty six receptacles (or eighteen duplex receptacles).

Substantiation: The vast expansion of electrically powered equipment in critical care areas and in operating rooms demands that the minimum number of electrical receptacles be increased. Modern operating rooms have an array of line powered equipment including monitors, anesthesia machines, patient warmers, fluid warmers, electrocautery, x-ray, and microscopes. The amount of line powered equipment is constantly increasing. Eighteen receptacles in a critical care area and thirty six in an operating room are barely adequate for today's needs, much less being prepared for future needs. Finally, in order to effectively utilize all of the operating room space, there must be receptacles on every wall of the operating room.

Committee Meeting Action: Accept in Principle
Committee Statement: See action on Committee Proposal 99-90 (Log #CP314).
Submitter: Steve Montgomery, OFI Inc.
Recommendation: Insert additional wording to this section to read:

4.3.2.6.2(D) Receptacles for Special Area. Receptacles shall not be required in areas where medical requirements mandate otherwise (e.g., certain psychiatric, pediatric, or hydrotherapy areas). Receptacles located within the rooms, bathrooms, playrooms, activity rooms, and patient care areas of pediatric wards shall be listed Tamper Resistant or shall be of the Shock Fault Circuit Interrupted (SFCI) type.

Substantiation: U.S. Consumer Product Safety Commission (CPSC) conducted a 10 year study (1991 - 2001) of National Electronic Injury Surveillance Systems (NEISS). The data shows 24,000 + children under 10 years old were treated in Emergency Rooms for incidents related to electrical receptacles. A similar study done by Canadian Hospitals Injury Reporting and Prevention Program (CHIRPP) 8 Year Study (1996-2003) from 14 CHIRPP Hospitals 465 children under 9 years old were treated in Emergency Rooms for Incidents related to electrical receptacles. The National Electrical Code, NFPA 70 2005-2008, has added requirements for tamper resistant receptacles in dwellings and Health Care pediatric areas.

GFCI outlets and breakers are designed and tested to prevent death for most adults from line to ground leakage, but do not protect against death from line to neutral contact. Young adults and children have a lower resistance to electrical current affects and are more vulnerable to injury.

Protection from line-to-neutral shocks is needed around children, since they do not all recognize the shock hazards and risks. Tamper Resistance outlets use a mechanical insulating shutter system to shield children from accessing live voltages on electrical receptacle sockets. Shock Fault Circuit Interrupters (SFCI) uses a relay to normally disconnect electricity at the receptacle sockets. SFCI only turns electricity on at the socket when it detects the insertion of an electrical plug. The detection mechanism is an RFID tag embedded in a device plug or attached to the face of a device plug that complies with the RightPlug standard (www.rightplug.com). Both Tamper Resistance and SFCI outlets provide a reasonable means of preventing line-to-neutral shocks.

Underwriters Labs is in process of establishing a standard for Overload Fault Circuit Interrupters of which Shock Fault Circuit Interrupters is a part of.

Adding this requirement to NFPA 99 will improve the safety of persons from the affect of electricity.

This is not original material; its reference/source is as follows:
NFPA 70, National Electrical Code; National Electrical Manufacturers Assn. (NEMA); CPSC and CHIRPP data, www.rightplug.com; RightPlug tag information; proposed UL standard draft for OFCI; specification for SFCI.

Committee Meeting Action: Reject
Committee Statement: Shock fault circuit interrupters has no listing requirements. There is no evidence of a problem and unproven technology.

Submitter: Burton R. Klein, Burton Klein Associates
Recommendation: 1. Add the following after the term "Quiet Ground": "(insulated grounding terminal)."
2. Add a new sentence to read:
A quiet ground shall not be installed within a patient care vicinity.

Substantiation: 1. The term "Quiet Ground" should be clarified in the text, as opposed to relying on the definition in Chapter 3. Term is not used by everyone.
2. Since NFPA 70, section 517.13 requires "redundant grounding" in patient care areas, the installation of a "quiet ground" within a patient care vicinity would not be acceptable. Thus, installation should be acceptable outside the patient care vicinity. [May need to correlate with NEC Panel responsible for Article 517.]

Committee Meeting Action: Accept in Principle
Committee Statement: See action on Committee Proposal 99-94 (Log #CP315).
99-94  Log #CP315 HEA-ELS  (4.3.2.2.7.1)  Final Action: Accept

Submitter: Technical Committee on Electrical Systems,
Recommendation:  Revise to read as follows:
4.3.2.2.7.1* Use of Isolated Ground Receptacles.
(A) An isolated ground receptacle, if used, shall not defeat the purposes of the safety features of the grounding systems detailed herein.
(B) An isolated ground receptacle shall not be installed within a patient care vicinity.
3.3.153 Delete the definition of Quiet Ground.
Substantiation:  The term quiet ground is outdated. Prohibiting the use of isolated ground receptacles in a patient care area coincides with the actions of NFPA 70.

Committee Meeting Action:  Accept
Committee Statement:  This can be found in section 6.3.2.2.7.1 in the preprint.

99-95  Log #76 HEA-ELS  (4.3.2.2.8.1(2))  Final Action: Accept

Submitter: Burton R. Klein, Burton Klein Associates
Recommendation:  1. Revise subparagraph (2) to read as follows:
A power distribution system in which the power supply is interrupted if the ground-fault current does, in fact, exceed \(6 \text{ mA}\) the trip value of a Class A GFCI.
2. Add new Annex A.4.3.2.2.8.1(2) to read as follows:
A.4.3.2.2.8.1(2) Class A GFCIs trip at currents between 4 and 6 ma.
Substantiation:  GFCIs have nominal trip ranges since several factors affect the value at which a GFCI will trip. Class A GFCIs have a nominal trip range of 4 to 6 ma.
Committee Meeting Action:  Accept
Committee Statement:  See section 6.3.2.2.8.1(2) of the preprint.

99-96  Log #CP330 HEA-ELS  (4.3.2.2.8.3, A.4.2.2.8.3)  Final Action: Accept

Submitter: Technical Committee on Electrical Systems,
Recommendation:  Add new section as follows and renumber:
4.3.2.2.8.3* Operating rooms shall be considered to be a wet procedure location unless a risk assessment conducted by the health care governing body determines otherwise.
A.4.3.2.2.8.3 In conducting a risk assessment, the health care governing body should consult with all relevant parties, including, but not limited to, clinicians, biomedical engineering staff, and facility safety engineering staff.
Substantiation:  The committee supports the concept that operating rooms are often wet procedure locations but has included the provision for conducting a risk assessment to determine otherwise. The committee concurs that, where a risk assessment concludes that an operating room is not a wet procedure location, such designation is not necessary.
Committee Meeting Action:  Accept
Committee Statement:  See section 6.4.2.2.8.3 in the preprint.
99-97  Log # CP332  HEA-ELS  
(4.3.2.2.8.5)  
Final Action: Accept

Submitter: Technical Committee on Electrical Systems,  
Recommendation: Delete section 4.3.2.2.8.5  
Where power interruption under first fault condition (line-to-ground fault) is tolerable, the use of a ground-fault circuit interrupter (GFCI) shall be permitted as the protective means that monitors the actual ground-fault current and interrupts the power when that current exceeds 6 mA.

Substantiation: The committee wishes to reinforce that both GFCI and isolated power systems are an acceptable means for mitigating risk and protecting the wet environment.  
Committee Meeting Action: Accept

99-98  Log # CP331  HEA-ELS  
(4.3.2.2.8.6)  
Final Action: Accept

Submitter: Technical Committee on Electrical Systems,  
Recommendation: Add new section to read as follows:  
4.3.2.2.8.6 Operating rooms defined as wet procedure locations shall be protected by either isolated power or ground fault circuit interrupters.

Substantiation: The committee wishes to reinforce that both GFCI and isolated power systems are an acceptable means for mitigating risk and protecting the wet environment.  
Committee Meeting Action: Accept  
Committee Statement: See section 6.3.2.2.8.6 in the preprint.

99-99  Log # 31  HEA-ELS  
(4.3.2.6.3.4)  
Final Action: Accept in Principle

Submitter: Burton R. Klein, Burton Klein Associates

Recommendation: Move the last sentence:  
"It is desirable to locate the ammeter such that it is conspicuously visible to persons in the anesthetizing location." to new A.4.3.2.6.3.4.

Substantiation: Conform to NFPA Manual of Style for text that is not mandatory, i.e., locate recommendations in Annex of a standard.

Committee Meeting Action: Accept in Principle  
Committee Statement: Announcement in an operating room of a problem with equipment that activates the LIM of an isolated power system is more helpful for staff and patient safety than for announcement to occur in a corridor outside an operating room. Operating room personnel will know immediately that something has raised the leakage current in the ground above the 5 mA, and they can begin to assess which equipment may have tripped alarm (if it was equipment that tripped the alarm).  
See section A.6.3.2.6.3.4 of the preprint.
The voltage measurements shall be made under no-fault conditions between a reference point and exposed fixed electrical equipment with conductive surfaces in a patient care vicinity area. The voltage measurements shall be made with an accuracy of ± 20 percent. Voltage measurements for faceplates of wiring devices shall not be required.

4.3.3.1.4* Impedance Measurements. The impedance measurement shall be made with an accuracy of ±20 percent. For new construction, the impedance measurement shall be made between the reference point and the grounding contact of 10 percent of all receptacles within the room. The impedance measurement shall be the ratio of voltage developed (either 60 Hz or dc) between the point under test and the reference point to the current applied between these two points.

Substantiation: Given the definition of 'patient care vicinity,' and the size of many rooms in which a patient is treated (including the equipment which can be connected to him or her), voltage and impedance testing needs to include those receptacles, etc., outside the patient care vicinity.

Committee Meeting Action: Accept in Principle

Revise as follows:
4.3.3.1.4* Impedance Measurements. The impedance measurement shall be made with an accuracy of ±20 percent. For new construction, the impedance measurement shall be made between the reference point and the grounding contact of 10 percent of all receptacles within the room. The impedance measurement shall be the ratio of voltage developed (either 60 Hz or dc) between the point under test and the reference point to the current applied between these two points. Note: Recommendation under 1 was not accepted.

Committee Statement: The committee action clarifies the intended number and location of receptacles that are to be tested.

See section 6.3.3.1.4 of the preprint.
Add a new 4.3.3.5 and A.4.3.3.5.2 to read as follows:

4.3.3.5 Testing Personnel.
4.3.3.5.1 The testing required in 4.3.3.1 to 4.3.3.4 shall be conducted by the party who installed the equipment. A written record of results shall be submitted to the governing board of the facility or his/her designated representative.

A.4.3.3.5.2* After the testing of 4.3.3.5.1 is completed, the results shall be verified by a party or parties contractually independent of the party who installed and conducted the testing of 4.3.3.5.1. A written record of results shall be submitted to the governing board of the facility or his/her designated representative.

A.4.3.3.5.2 Examples of verifiers include: (1) designer of record; (2) technically qualified verifier of electrical distribution systems.

1. Current text is silent on who should perform the testing required in 4.3.3 in order to ensure all equipment that has been installed according to design and any listing in fact meets the performance criteria listed.
2. Independent corroboration of testing results is considered warranted to confirm results of installer.
3. Correlate with testing and verification procedures required for piped gas and vacuum systems in Chapter 5 of NFPA 99.

Add at end of paragraph the following: ", but not exceeding 3 years" so that paragraph reads:

"Additional testing of receptacles in patient care areas shall be performed at intervals defined by documented performance data, but not exceeding 3 years."

1) Current wording permits extrapolation to that of doing no testing if no incidents are recorded after 6 months, then 12 months, then 1 year, etc.. No electrical equipment should be continued in use without some inspection or testing during its use within facility, particularly receptacles in patient care areas where plugs of electrical equipment are inserted and removed much more often than in non-patient care areas. This increased 'wear and tear' suggested at last some periodic inspection and/or testing.
2) This issue raised by hospital engineers at a workshop on healthcare electrical systems.
4.4.1.1.7.1 The generating equipment used shall be either reserved exclusively for such service or normally used for other purposes of peak demand control, internal voltage control, load relief for the external utility, or cogeneration. If normally used for the other purposes listed previously, two or more sets shall be installed, such that the maximum actual demand likely to be produced by the connected load of the life safety and critical branches as well as medical air compressors, medical–surgical vacuum pumps, electrically operated fire pumps, jockey pumps, fuel pumps, and generator accessories shall be met by a multiple generator system with the largest generator set out of service (not available).

The alternate source of emergency power for illumination and identification of means of egress shall be the essential electrical system. The alternate power source for fire protection signaling systems shall be the essential electrical systems.

**Substantiation:** Adding the qualifier regarding multiple generator sets and the parenthetical better expresses the intent of the section.

**Committee Meeting Action:** Accept

**Committee Statement:** See section 6.4.1.1.7.1 in the preprint.

4.4.1.1.8.1 The Emergency Power Supply (EPS) shall be installed in a separate room for Level 1 installations. Emergency Power Supply System (EPSS) equipment shall be permitted to be installed in this room. [110:7.2.1]

**Substantiation:** Change made to comply with the style manual.

**Committee Meeting Action:** Accept

**Committee Statement:** See section 6.4.1.1.8.1 in the preprint.

4.4.1.1.9 Capacity and Rating. The generator set(s) shall have sufficient capacity and proper rating to meet the maximum actual demand likely to be produced by the connected load of the essential electrical system(s) at the time of installation.

**Substantiation:** This section (4.4.1) covers requirements only for "new" sources.

**Committee Meeting Action:** Accept in Principle

**Committee Statement:** The requirement does not address the time of operation. The committee acknowledges that the words "at any one time" are confusing.

See section 6.4.1.1.9 of the preprint.
4.4.1.1.17.5 A centralized computer system (e.g., building automation systems) shall not be permitted to be substituted for the alarm annunciator in 4.4.1.1.1.17, but shall be permitted to be used to supplement the alarm annunciator.

Substantiation: Since emergency power systems may be in a separate building, there is a need to provide supplemental monitoring for these systems. Similar wording can be found used for Med Gas Alarm monitoring NFPA 99 - 2002, 5.1.9.2.2 and NFPA 99 - 1999, 4.3.1.2.2.

This is not original material; its reference/source is as follows:

Similar wording found in NFPA 99 - 2002, 5.1.9.2.2 for med gas alarms.

Committee Meeting Action: Accept

Committee Statement: This is section 6.4.1.1.17.5 of the preprint.
Add three new sections (4.4.2.1.2, 4.5.2.1.1 and 4.6.2.2.2) to read as follows and renumber existing:

4.4.2.1.2* Selective Coordination.
4.4.2.1.2.1 Overcurrent protective devices serving the essential electrical systems shall be selectively coordinated down to 0.1 second.
4.4.2.1.2.2 Selective coordination shall not be required as follows:
   (1) Between transformer primary and secondary overcurrent protective devices, where only one overcurrent protective device or set of overcurrent protective devices exists on the transformer secondary. [70:700.27]
   (2) Between overcurrent protective devices of the same size (ampere rating) in series. [70:700.27]
4.5.2.1.1* Selective Coordination.
4.5.2.1.1.1 Overcurrent protective devices serving the essential electrical systems shall be selectively coordinated down to 0.1 second.
4.5.2.1.1.2 Selective coordination shall not be required as follows:
   (1) Between transformer primary and secondary overcurrent protective devices, where only one overcurrent protective device or set of overcurrent protective devices exists on the transformer secondary. [70:700.27]
   (2) Between overcurrent protective devices of the same size (ampere rating) in series. [70:700.27]
4.6.2.1.1* Selective Coordination.
4.6.2.1.1.1 Overcurrent protective devices serving the essential electrical systems shall be selectively coordinated down to 0.1 second.
4.6.2.1.1.2 Selective coordination shall not be required as follows:
   (1) Between transformer primary and secondary overcurrent protective devices, where only one overcurrent protective device or set of overcurrent protective devices exists on the transformer secondary. [70:700.27]
   (2) Between overcurrent protective devices of the same size (ampere rating) in series. [70:700.27]

Add three new annex sections for each of these sections (A.4.4.2.1.2, A.4.5.2.1.1, and A.4.6.2.1.1) to read:

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 could compromise safety and system reliability. 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.

Substantiation: Selective coordination is only one of several competing (New) factors that must be considered in the selection of appropriate overcurrent protective devices (OCPDs) in health care facilities. Other factors that must be considered in the selection of overcurrent protective devices include: arc flash risk hazard, equipment damage, and reduced risk of extended outages; all of which have direct effects on both staff and patient safety. Mandating selective coordination below 0.1 second as the sole determining factor in OCPD selection will result in diminished reliability of the essential electrical system.

The method of application of selective coordination directly affects the performance of the essential electrical system in a health care facility. Establishment and management of this type of performance criterion traditionally belongs under the purview of this committee.

Committee Meeting Action: Accept
Committee Statement: See sections 6.4.2.1.2, 6.5.2.1.1 and 6.6.2.1.1 in the preprint.
4.4.2.2 Branches.

4.4.2.2.1* General.

4.4.2.2.1.1 The essential electrical system shall be divided into three branches: life safety, critical, and equipment.

4.4.2.2.1.2 The division between the branches shall occur at transfer switches where more than one transfer switch is required.

4.4.2.2.1.3 Each branch shall be arranged for connection, within time limits specified in this chapter, to an alternate source of power, following a loss of the normal source.

4.4.2.2.1.4 The number of transfer switches to be used shall be based upon reliability, design, and load considerations.

(A) Each branch of the essential electrical system shall have one or more transfer switches.

(B) One transfer switch shall be permitted to serve one or more branches or systems in a facility with a continuous load on the switch of 150 kVA (120 kW) or less.

4.4.2.2.2 Feeders from Alternate Source.

4.4.2.2.2.1 A single feeder supplied by a local or remote alternate source shall be permitted to supply the essential electrical system to the point at which the life safety, critical, and equipment branches are separated.

4.4.2.2.2.2 Installation of the transfer equipment shall be permitted at other than the location of the alternate source.

4.4.2.2.3 Life Safety Branch.

4.4.2.2.3.1 General.

(A) The life safety branch shall be limited to circuits essential to life safety.

(B) The life safety branch shall supply power for the lighting, receptacles, and equipment as follows:

1. Illumination of means of egress in accordance with NFPA 101, Life Safety Code
2. Exit signs and exit directional signs in accordance with NFPA 101, Life Safety Code
3. Hospital communication systems, where used for issuing instruction during emergency conditions
4. Generator set location: Task illumination, battery charger for emergency battery-powered lighting unit(s), and select receptacles at the generator set location and essential electrical system transfer switch locations
5. Elevator cab lighting, control, communication, and signal systems
6. Electrically powered doors used for building egress
7. Fire alarms and auxiliary functions of fire alarm combination systems complying with NFPA 72, National Fire Alarm and Signaling Code

(C) Alarm and alerting systems (other than fire alarm systems) shall be connected to the life safety branch or critical branch

(D) Loads dedicated to a specific generator, including fuel transfer pump(s), ventilation fans, electrically operated louvers, controls, cooling system, and other generator accessories essential for generator operation shall be connected to the life safety branch or the output terminals of the generator with overcurrent protective devices.

(E) No function other than those listed in items 6.4.2.2.3.1(B), (C) and (D) shall be connected to the life safety branch, except as specifically permitted in 6.4.2.2.3.

4.4.2.2.3.3* Critical Branch.

(A) The critical branch shall be permitted to be subdivided into two or more branches.

(B) The critical branch shall supply power for task illumination, fixed equipment, select receptacles, and select power circuits serving the following areas and functions related to patient care:

1. Critical care areas that utilize anesthetizing gases, task illumination, select receptacles, and fixed equipment
2. Isolated power systems in special environments
3. Task illumination and select receptacles in the following:
   a. Patient care rooms, including infant nurseries, selected acute nursing areas, psychiatric bed areas (omit receptacles), and ward treatment rooms
   b. Medication preparation areas
   c. Pharmacy dispensing areas
   d. Nurses’ stations (unless adequately lighted by corridor luminaires)
4. Additional specialized patient care task illumination and receptacles, where needed
5. Nurse call systems
Blood, bone, and tissue banks

(7)* Telephone equipment rooms and closets

(8) Task illumination, select receptacles, and select power circuits for the following areas:
   (a) General care beds with at least one duplex receptacle per patient bedroom, and task illumination as required by the governing body of the health care facility
   (b) Angiographic labs
   (c) Cardiac catheterization labs
   (d) Coronary care units
   (e) Hemodialysis rooms or areas
   (f) Emergency room treatment areas (select)
   (g) Human physiology labs
   (h) Intensive care units
   (i) Postoperative recovery rooms (select)

(9) Additional task illumination, receptacles, and select power circuits needed for effective facility operation.

Single-phase fractional horsepower motors shall be permitted to be connected to the critical branch.

4.4.2.2.4 Equipment Branch.

4.4.2.2.4.1 General. The equipment system shall be connected to equipment described in 4.4.2.2.4.3 through 4.4.2.2.4.4.

4.4.2.2.4.2 Connection to Alternate Power Source.

(A) The equipment system shall be installed and connected to the alternate power source, such that equipment described in 4.4.2.2.4.3 is automatically restored to operation at appropriate time-lag intervals following the energizing of the life safety and critical branches.

(B) Its arrangement shall also provide for the subsequent connection of equipment described in 4.4.2.2.4.4.

4.4.2.2.4.3* Equipment for Delayed-Automatic Connection. The following equipment shall be permitted to be arranged for delayed-automatic connection to the alternate power source:

(1) Central suction systems serving medical and surgical functions, including controls. It shall be permitted to place such suction systems on the critical branch.

(2) Sump pumps and other equipment required to operate for the safety of major apparatus, including associated control systems and alarms.

(3) Compressed air systems serving medical and surgical functions, including controls. It shall be permitted to place such air systems on the critical branch.

(4) Smoke control and stair pressurization systems.

(5) Kitchen hood supply and/or exhaust systems, if required to operate during a fire in or under the hood.

(6) Supply, return, and exhaust ventilating systems for airborne infectious/isolation rooms, protective environment rooms, exhaust fans for laboratory fume hoods, nuclear medicine areas where radioactive material is used, ethylene oxide evacuation, and anesthetic evacuation. Where delayed automatic connection is not appropriate, such ventilation systems shall be permitted to be placed on the critical branch.

4.4.2.2.4.4* Equipment for Delayed-Automatic or Manual Connection. The following equipment shall be permitted to be arranged for either delayed-automatic or manual connection to the alternate power source (also see A.4.4.2.2.4.3):

(1) Heating equipment to provide heating for operating, delivery, labor, recovery, intensive care, coronary care, nurseries, infection/isolation rooms, emergency treatment spaces, and general patient rooms; and pressure maintenance (jockey or make-up) pump(s) for water-based fire protection systems

(2)* Heating of general patient rooms during disruption of the normal source shall not be required under any of the following conditions:
   (a) The outside design temperature is higher than -6.7°C (+20°F).
   (b) The outside design temperature is lower than -6.7°C (+20°F) and a selected room(s) is provided for the needs of all confined patients [then only such room(s) need be heated].

(3) Elevator(s) selected to provide service to patient, surgical, obstetrical, and ground floors during interruption of normal power

(4) Supply, return, and exhaust ventilating systems for surgical and obstetrical delivery suites, intensive care, coronary care, nurseries, and emergency treatment spaces

(5) Hyperbaric facilities

(6) Hypobaric facilities

(7) Autoclaving equipment shall be permitted to be arranged for either automatic or manual connection to the alternate source

(8) Controls for equipment listed in 4.4.2.2.4

(9)* Other selected equipment
4.4.2.2.5 Wiring Requirements.
4.4.2.2.5.1* Separation from Other Circuits. The life safety branch and critical branch shall be kept independent of all other wiring and equipment.
4.4.2.2.5.2 Receptacles. The requirements for receptacles shall comply with 4.4.2.2.5.2(A) and 4.4.2.2.5.2(C).
   (A) The number of receptacles on a single branch circuit for areas described in 4.4.2.2.3.3(8) shall be minimized to limit the effects of a branch circuit outage.
   (B) Branch circuit overcurrent devices shall be readily accessible to authorized personnel.
   (C)* The electrical receptacles or the cover plates for the electrical receptacles supplied from the life safety and critical branches shall have a distinctive color or marking so as to be readily identifiable.
4.4.2.2.5.3 Switches. Switches of all types shall be permitted in the lighting circuits connected to the essential electrical system and that do not serve as the illumination of egress as required by NFPA 101, Life Safety Code.
4.4.2.2.5.4 Mechanical Protection of the Life Safety and Critical Branches. The wiring of the life safety and critical branches shall be mechanically protected by raceways, as defined in NFPA 70, National Electrical Code.
4.4.2.2.5.5 Flexible power cords of appliances or other utilization equipment connected to the life safety and critical branches shall not be required to be enclosed in raceways.
4.4.2.2.5.6 Secondary circuits of transformer-powered communication or signaling systems shall not be required to be enclosed in raceways unless otherwise specified by Chapters 7 or 8 of NFPA 70, National Electrical Code.

Substantiation: The use of "emergency system" in Chapter 4 results in confusion between proper application of the requirements in this standard and those in NFPA 70. Designating the essential electrical system as three branches (critical, life safety, and equipment) eliminates an unnecessary hierarchal level. This revision results in a clear distinction between the requirements for essential systems of health care facilities and those in NFPA 70 for emergency, legally required standby, and optional standby systems in other occupancies. Although some functions of the essential electrical system do have commonality with functions of emergency and standby systems in other occupancies, there are many patient care related functions that are uniquely performance related and apply only in the health care environment. Establishing the performance requirements for these systems is clearly in the purview of this technical committee.

The committee action on 4.4.2.2.1.1 correlates with the provision in 4.4.2.2.1.4 that permits a single transfer switch for systems with loads of 150 kVA or less.
In section 4.4.2.2.2, feeders from alternate sources was added because the present requirements of NFPA 70, Article 445 and Article 700 as applied to healthcare facilities essentially eliminates central plant alternate power source applications by requiring additional multiple feeders (and in the case of generation systems greater than 600V, additional transformers) emanating from the source to the system distribution equipment.
This new requirement in the NEC provides no proven increase in reliability. In fact, by in effect mandating the use of distributed generation over central plant architecture it can be argued that reliability will be decreased. This proposal permits a single feeder from a health care facility central generating plant to serve the essential electrical system of a remote healthcare building or buildings within the same campus.
Fire alarms are required on the Life Safety Branch, however, other alarms are allowed on either Life Safety Branch or Critical Branch. This adds flexibility for other alarms.
Automatic doors was changed to electrically operated doors because the intent was to have doors that are electrically operated on the Life Safety Branch and not restrict automatically operated to the Life Safety Branch.
Without operation of generator accessories, the generators will not function. The loads for the equipment spaces are very small, and must be the first loads onto the generator to ensure the ability to operate these spaces effectively.
Section 4.4.2.2.3.5.(2)(c) was deleted because:
1. Section 4.3.2.1 refers to installation being in accordance with NFPA 70. This reference is not relevant to the issue of heating of patient rooms.
2. If normal power is interrupted, having dual sources of normal power will not provide power-continuity and thus heating of patient rooms. (See 4.4.1.1.1.)

Committee Meeting Action: Accept
Committee Statement: This can be found in section 6.4.2.2 in the preprint.
99-109 Log #32 HEA-ELS  
(4.4.2.2.2(3)(b))  
Final Action: Accept in Principle  

Submitter: Burton R. Klein, Burton Klein Associates  

Recommendation: Move 4.4.2.2.2(3)(b):  
"Alarms required for systems used for the piping of nonflammable medical gases as specified in Chapter 5, Gas and Vacuum Systems" to 4.4.2.2.2.3, and designate it new subparagraph (9).  
Renumber current subparagraph (9) as new subparagraph (10).  

Substantiation: Section 4.4.2.2.2 covers wiring intended for electrical equipment or systems needed for exiting a facility in an emergency that necessitates evacuating a facility. Section 4.4.2.2.3 covers wiring intended for electrical equipment or systems needed for maintaining patient care. (Note: this proposal may have to be correlated between T/C Electrical Systems and T/C Piping Systems.)  

Committee Meeting Action: Accept in Principle  
Committee Statement: See action on Committee Proposal 99-108 (Log #CP313).  

99-110 Log #108 HEA-ELS  
(4.4.2.2.2(3)(b))  
Final Action: Accept in Principle  

Submitter: Burton R. Klein, Burton Klein Associates  

Recommendation:  
1. Move this text "Alarms required for systems used for the piping of nonflammable medical gases as specified in Chapter 5, Gas and Vacuum Systems" to 4.4.2.2.2.3, and number it new subparagraph (9); and revise to read: "Alarms required for systems used for the piping of nonflammable medical gases and medical vacuum as specified in Chapter 5, Gas and Vacuum Systems."
2. Renumber existing subparagraph (9) as new subparagraph (10).  

Substantiation:  
1. Section 4.4.2.2.2 covers items related to life safety issues associated with exiting a building, such as the fire alarm system. Alarms for nonflammable medical gases are needed for patient safety. Alarms are also included for piped medical vacuum system for patient safety, and thus should be wired for connection to emergency power in the event normal power is interrupted.  
2. Renumbering necessary if new text is added.  

Committee Meeting Action: Accept in Principle  
Committee Statement: See action on Committee Proposal 99-108 (Log #CP313).  

99-111 Log #86 HEA-ELS  
(4.4.2.2.2(7))  
Final Action: Accept in Principle  

Submitter: Burton R. Klein, Burton Klein Associates  

Recommendation: Add at the end of 4.4.2.2.2.2(7) the following:  
"(whether controlled by motion-detectors or pressure activated)" so that item (7) reads:  
"Automatically operated doors used for building egress, whether controlled by motion-detectors or pressure activated"  
(change underlined)  

Substantiation: Reports at workshops have indicated that there are questions whether pressure activated doors can be considered 'automatically' operated doors. The consensus at workshops has been such doors should be considered 'automatically' operated doors.  

Committee Meeting Action: Accept in Principle  
Committee Statement: See action on Committee Proposal 99-108 (Log #CP313).
Recommendation: Revise text to read as follows:
Additional task illumination, receptacles, and selected power circuits needed for effective facility operation patient care. Single-phase fractional horsepower motors shall be permitted to be connected to the critical branch.

Substantiation: Term "effective facility operation" is very broad, and being interpreted by some in the field as extending to just about the entire facility. Original intent of essential electrical system was to provide power only to those activities relating to patient care so that patients could continue to receive treatment without having to be moved, if possible.

Committee Meeting Action: Reject
Committee Statement: The intent of this requirement is to allow facilities to determine what is necessary to successfully operate during power outages. The recommendation unnecessarily restricts design flexibility.

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Recommendation: Delete 4.4.2.2.3.5(2)(c).

Substantiation: 1. Section 4.3.2.1 refers to installation being in accordance with NFPA 70. This reference is not relevant to the issue of heating of patient rooms.
2. If normal power is interrupted, having dual sources of normal power will not provide power-continuity and thus heating of patient rooms. (See 4.4.1.1.1.)

Committee Meeting Action: Accept

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Recommendation: Revise to read as follows:
4.4.2.2.4.3 Switches. Switches of all types shall be permitted in the lighting circuits connected to the essential electrical system and that do not serve as the illumination of egress as required by NFPA 101, Life Safety Code.

Substantiation: The use of task lighting connected to the essential electrical system installed in health care facilities mandates the use of switches.

Committee Meeting Action: Accept
Committee Statement: See section 6.4.2.2.5.3 in the preprint.

99-115 Log #CP317 HEA-ELS
(4.4.4.1.1.1, 4.4.4.1.1.2) Final Action: Accept

Submitter: Technical Committee on Electrical Systems,
Recommendation: Revise as follows:
4.4.4.1.1.1 Maintenance of Alternate Power Source. The generator set or other alternate power source and associated
equipment, including all appurtenance parts, shall be so maintained as to be capable of supplying service within the
shortest time practicable and within the 10-second interval specified in 4.4.1.1.10 and 4.4.3.1.
4.4.4.1.1.2 The 10-second criteria shall not apply during the monthly testing of an essential electrical system. If the
10-second criteria is not met during the monthly test, a process shall be provided to annually confirm the capability of
the life safety and critical branches to comply with 4.4.3.1. Maintenance shall be performed in accordance with NFPA
Substantiation: When testing is performed using a test switch on an ATS, normal power is still available to the
system. This presents a significant problem for systems with utility paralleling, closed transition, or in phase transfer to
meet the 10-second criteria for picking up the essential load. The standard established the 10-second criteria for when
the normal power is lost, and not as a testing criterion for the monthly load test.
Committee Meeting Action: Accept
Committee Statement: This can be found in section 6.4.4.1.1 in the preprint.

99-116 Log #33 HEA-ELS
Final Action: Accept in Principle

Submitter: Burton R. Klein, Burton Klein Associates
Recommendation: 1. Revise title of 4.5.2.2.3 to read: "4.5.2.2.3 Equipment System".
2. Change "critical system" to "equipment system" wherever it appears in 4.5.2.2.3.
Substantiation: 1. Except for first item listed in 4.5.2.2.3.3, all items in this section are "equipment related" (similar to
4.4.2.2.3 which uses term "Equipment" to describe these items). When nursing homes or limited care facilities begin to
treat "patients" (and some already are), they will have to provide for a "critical branch". Thus, this change is
recommended now in order to prevent confusion in the future over the term "critical."
2. A similar proposal is being submitted on NFPA 70, Article 517 for correlation purposes.
Committee Meeting Action: Accept in Principle
Revise title of 4.5.2.2.2 to read, "Life safety branch."
2. Revise title of 4.5.2.2.3 to read, "Equipment branch."
Committee Statement: Correlate with action of Committee Proposal 99-39 (Log #CP312).
7.1* Applicability.
This chapter shall apply to information technology and communications systems in all health care facilities that provide services to human beings.

7.2 Reserved.

7.3 Category 1 Systems.
7.3.1 Information Technology and Communications Systems Infrastructure.
7.3.1.1 Premises Distribution System (Fiber and Copper).
7.3.1.1.1 Cables and installation shall be in compliance with NFPA 70, National Electrical Code, and EIA/TIA 568-B.
7.3.1.1.2 Distribution system cable labeling, record keeping, and alphanumeric schemes shall be in accordance with TIA/EIA-606-A.

7.3.1.2* Telecommunications Systems Spaces and Pathways.
7.3.1.2.1 Entrance Facility (EF).
7.3.1.2.1.1 General. This location shall be permitted to be combined with the telecommunications equipment room (TER).
7.3.1.2.1.2 Not less than two physically separated service entrance pathways into this location shall be required.
7.3.1.2.1.3 Remote Primary Data Center.
(A) In a facility where the primary data center is located remotely, two entrance facilities (EF) and redundant telecommunications service entrances shall be provided.
(B)* Electronic storage with a minimum capacity to store all inpatient records shall be provided at the building.
7.3.1.2.1.4 Location Requirements and Restrictions.
(A) The EF shall be permitted to be located with the ER. Where the EF is combined with the ER, the space and electrical power and cabling shall be added to the ER to accommodate the telecommunications service provider’s space and access requirements.
(B) The EF shall be dedicated to the telecommunications function and related support facilities.
(C) Electrical equipment or fixtures (e.g., transformers, panelboards, conduit, wiring, etc.) that are not directly related to the support of the EF shall not be installed in or pass through the EF.
(D) Mechanical equipment and fixtures (e.g., water or drainage piping of any kind, ductwork, pneumatic tubing, etc.) that are not directly related to the support of the EF shall not be installed in, pass through, or enter the EF.
(E) Other underground utilities, such as electrical, water, gas, and sewer, shall not be located below the EF.
(F) The EF shall be located not less than 3.66 m (12 ft) from any permanent source of electromagnetic interference such as medical imaging equipment, transformers, motors, variable frequency drives, induction heaters, arc welders, radio and radar systems, or other sources of electromagnetic interference.
(G) The EF shall be located in an area not subject to flooding and shall be as close as practicable to the building communications service entrance point.
7.3.1.2.1.5 Power Requirements.
(A) Circuits serving the EF shall be dedicated to serving the EF.
(B)* Circuits serving equipment in the EF shall be connected to the critical power branch of the emergency electrical system.
(C) A minimum of one duplex receptacle served from normal power shall be provided on one wall of the EF for service and maintenance.
7.3.1.2.1.6 Environmental Requirements.
(A) Temperature and humidity in the TER shall be controlled in accordance with the manufacturer’s equipment requirements.
(B) HVAC systems serving the TER shall be connected to the equipment branch of the essential electrical system.
(C) A positive-pressure differential with respect to surrounding areas shall be provided.
7.3.1.2.1.7 Fire Suppression Systems. Sprinkler heads shall be provided with wire cages or shall be recessed to prevent accidental operation.
7.3.1.2.2 Telecommunications Equipment Room (TER).
7.3.1.2.2.1 General. The TER houses the main networking equipment and shall be permitted to also house application servers and data storage devices that serve the health care facility if the TER is being utilized as a data center. In
addition, central equipment for other communications systems shall be permitted to be housed in the TER.

7.3.1.2.2.2* The TER shall be a separate space and shall not be used for any other purposes besides networking, data storage, and processing, except that the TEF can be combined with the TER space.

7.3.1.2.2.3 Each facility shall have at least one TER space that meets the minimum requirements of this chapter.

7.3.1.2.2.4 Working Space. Working space about communications cabinets, racks, or other equipment shall be in accordance with Section 110.26(A) of NFPA 70, National Electrical Code.

7.3.1.2.2.5 Location Requirements and Restrictions.

(A) Electrical equipment or fixtures (e.g., transformers, panelboards, conduit, wiring, etc.) that are not directly related to the support of the TER shall not be installed in, pass through, or enter the TER.

(B) Any mechanical equipment or fixtures (e.g., water or drainage piping of any kind, ductwork, pneumatic tubing) not directly related to the support of the TER shall not be installed in, pass through, or enter the TER.

(C) The TER shall be located in a nonsterile area of the facility.

(D) In areas prone to hurricanes or tornados, the TER shall be located away from exterior curtain walls to prevent wind and water damage.

(E) The TER shall be located not less than 3.66 m (12 ft) from any permanent source of electromagnetic interference such as medical imaging equipment, transformers, motors, variable frequency drives, induction heaters, arc welders, radio transmission systems, or other sources of electromagnetic interference.

(F) The TER shall be located or designed to avoid vibration from mechanical equipment or other sources.

7.3.1.2.2.6 Security. Access to the TER shall be restricted and controlled.

7.3.1.2.2.7 Power Requirements.

(A) Circuits serving the TEF and the equipment within the TER shall be dedicated to serving the TEF.

(B) Circuits serving fire alarm, medical gas alarms, elevator communications, and communications systems used for issuing instructions during emergency conditions (e.g., fireman’s phone system) shall be connected to the life safety branch of the essential electrical system.

(C) Circuits serving other communications equipment in the TER shall be connected to the essential electrical system. This equipment shall include the telephone system, nurse call, staff assistance call, and code systems.

(D) A minimum of one duplex outlet shall be provided on each wall and shall be connected to normal power for service and maintenance.

(E) Consideration shall be given to the reliability of power supply to the HVAC equipment because of its important function within the TEF.

7.3.1.2.2.8 Environmental Requirements.

(A) Temperature and humidity in the TER shall be controlled in accordance with the manufacturer’s equipment requirements.

(B) HVAC systems serving the TER shall be connected to the equipment branch of the essential electrical system.

(C) A positive-pressure differential with respect to surrounding areas shall be provided.

7.3.1.2.3 Telecommunications Room (TR).

7.3.1.2.3.1 General. A TR houses telecommunications equipment, cable terminations, and cross-connect cabling.

7.3.1.2.3.2 Sufficient TRs shall be provided such that any data or communications outlet in the building can be reached without exceeding 90 m (292 ft) maximum pathway distance from the termination point in the TR to the outlet.

7.3.1.2.3.3 A minimum of one TR shall be on each floor of the facility.

7.3.1.2.3.4 A TR shall serve a maximum of 1858 m² (20,000 ft²) of usable space on a single floor.

7.3.1.2.3.5 Working Space. Working space about communications cabinets, racks, or other equipment shall be in accordance with Section 110.26(A) of NFPA 70, National Electrical Code.

7.3.1.2.3.6 Location Requirements and Restrictions.

(A) Switchboards, panelboards, transformers, and similar electrical equipment that are not directly related to the support of the TR shall not be installed in the TR.

(B) Any mechanical equipment or fixtures (e.g., water or drainage piping of any kind, ductwork, pneumatic tubing) not directly related to the support of the TR shall not be installed in, pass through, or enter the TR.

(C) In areas prone to hurricanes or tornados, TRs shall be located away from exterior curtain walls to prevent wind and water damage.

(D) The TR shall be located a minimum of 3.66 m (12 ft) from any permanent source of electromagnetic interference such as medical imaging equipment, transformers, motors, variable frequency drives, induction heaters, arc welders, radio transmission systems, or other sources of electromagnetic interference.

7.3.1.2.3.7 Security. Access to TRs shall be restricted and controlled.

7.3.1.2.3.8 Power Requirements.

(A) Circuits serving the TR and the equipment within the TR shall be dedicated to serving the TR.

(B) Circuits serving the TR shall be connected to the critical power branch of the emergency electrical system.
(C) A minimum of one duplex receptacle shall be provided in each TR and shall be connected to normal power for service and maintenance.

7.3.1.2.3.9 Environmental Requirements.
(A) Temperature and humidity in the TER shall be controlled in accordance with the manufacturer’s equipment requirements.
(B) Sprinkler heads shall be provided with wire cages to prevent accidental discharge.

7.3.1.2.3.10 Other Requirements. Dropped ceilings shall not be installed in the TR.

7.3.1.2.4 Cabling Pathways and Raceway Requirements.
7.3.1.2.4.1 Backbone Distribution. Redundant pathways shall be provided between the TEF and TER.
7.3.1.2.4.2 Conduits shall be provided for cabling in inaccessible ceiling spaces.
7.3.1.2.4.3 Conduits shall be provided for cabling in inaccessible ceiling spaces.
7.3.1.2.4.4 Conduits shall be provided in open ceiling spaces for cable protection.

7.3.1.2.5 Outside Plant (OSP) Infrastructure.
7.3.1.2.5.1 General. Outside plant infrastructure consists of the conduits, vaults, and other pathways and cabling used to connect buildings on a campus and to provide services from off-campus service providers.

7.3.1.2.5.2 Pathways.
(A) Dual telecommunications service entrance pathways shall be provided to the TEF.
(B) Service entrance pathways shall be a minimum of 6.1 m (20 ft) apart.
(C) Underground conduits for technology systems shall be a minimum of 0.61 m (2 ft) from underground steam and water piping if crossing perpendicularly, and a minimum of 1.83 m (6 ft) if parallel.
(D) Underground conduits for technology systems shall be a minimum of 0.61 m (2 ft) below grade.

7.3.1.3 Antennas (Reserved).
7.3.2 Voice, Data, Communications, and Cable Television Systems.
7.3.2.1 Voice/Telecommunications. (Reserved)
7.3.2.2 Local Area Networks (LANS). (Reserved)
7.3.2.3 Wireless LAN Systems and Public Wifi Hot Spots. (Reserved)
7.3.2.4 Wireless Voice Systems and In-Building Cellular Networks. (Reserved)
7.3.2.5 UHF, VHF, 800 MHz, and 900 MHz Radio Communication Systems. (Reserved)
7.3.2.6 Cable Television. (Reserved)
7.3.3 Other Communications Systems.
7.3.3.1 Nurse Call Systems.
7.3.3.1.1 General. The nurse call systems shall communicate patient and staff calls for assistance and information in health care facilities. The nurse call systems shall be audiovisual type and listed for the purpose.
7.3.3.1.1.1 The nurse call systems shall provide for communication of patient and staff calls for assistance and information, medical device alarms, and patient safety and security alarms.
7.3.3.1.1.2 Supplemental features shall be permitted to include call initiation to alphanumeric pagers and other wireless devices carried by health care facility staff.
7.3.3.1.2 Patient Area Call Station. Each patient bed location shall be provided with a calling device. No more than two calling devices, serving adjacent beds, shall be served by a single audiovisual call station providing two-way voice communication.
7.3.3.1.3 Signals. Activation of a patient bed calling device shall cause visual signal activation in the corridor at the patient room door, the associated nursing station, the calling station, and associated nursing unit support areas, including medication, nourishment, charting, storage, and exam/treatment rooms, and clean and soiled linen storage areas.
7.3.3.1.4 Additional visual signals shall be provided at corridor intersections where individual patient door signals are not directly visible from the central nursing station.
7.3.3.1.5 A visual signal indication shall be provided at each calling station indicating voice circuit operation.
7.3.3.1.6 Emergency Call. Each calling station shall be capable of initiating a visual and audible emergency signal, distinct from the regular nurse call signal, that can be turned off only at that station. The emergency call shall activate an annunciator at the nearest associated nursing station, a visual signal in the corridor at the patient room door, and other locations as directed by the facility.
7.3.3.1.6.1 Life safety and critical branches calling devices shall be provided at each inpatient toilet, bath, shower, or sitz bath, accessible to a patient lying on the floor. A pull cord shall be permitted to be used for this access.
7.3.3.1.6.2 Life safety and critical branches calling devices shall be provided in outpatient and treatment areas where patients can be incapacitated.
7.3.3.1.6.3 Life safety and critical branches calling devices shall be provided in patient toilet rooms in imaging suites, renal dialysis units, and similar areas.

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7.3.3.1.7 Staff Emergency Assistance Call.

7.3.3.1.7.1 An emergency assistance system for staff to summon additional assistance shall be provided in each operating, delivery, recovery, emergency, examination, treatment, and intermediate care area, and in critical care units, nurseries, special procedure rooms, cardiac catheterization rooms, stress test areas, triage, outpatient surgery, admission and discharge areas, and areas for psychiatric patients, including seclusion and security rooms, anterooms and toilet rooms serving them, communal toilet and bathing facility rooms, and dining, activity, therapy, exam, and treatment rooms.

7.3.3.1.7.2 Other communications systems that perform the same function shall be permitted.

7.3.3.1.8 Emergency Resuscitation Alarm. The call system shall include provisions for an emergency code resuscitation alarm to summon assistance from outside the unit for critical care, pre-op, recovery, and emergency units.

7.3.3.1.9 In areas where patients are under constant visual surveillance such as pre-op, recovery, and emergency units, the nurse call system shall be permitted to be limited to the staff emergency assistance call and the emergency resuscitation alarm. Two-way communication from the patient bed location shall not be required.

7.3.3.1.10 A nurse call system shall be provided for geriatric, Alzheimer’s, and other dementia units, but all hardware shall have tamper-resistant fasteners, provisions shall be made for removal or covering of call button outlets, and call cords or strings in excess of 15.24 cm (6 in.) shall not be permitted.

7.3.3.1.11 A nurse call system is not required in psychiatric units, but if one is included, all hardware shall have tamper-resistant fasteners, provisions shall be made for removal or covering of call button outlets, and control to limit unauthorized use is permitted.

7.3.3.2 The staff emergency assistance system shall annunciate each call visibly and audibly in the clean workroom, in the soiled workroom, in medication, charting, clean linen storage, nourishment, equipment storage, and examination/treatment rooms if provided, and at the nursing station of the associated nursing unit, with backup to another staffed area from which assistance can be summoned.

7.3.3.3 Patient Tracking. (Reserved)

7.3.3.4 Equipment and Asset Tracking. (Reserved)

7.3.3.5 Staff and Visitor Tracking. (Reserved)

7.3.3.6 Wireless Phone and Paging Integration. (Reserved)

7.3.3.7 Patient and Equipment Monitoring Systems. (Reserved)

7.3.3.8 Clinical Information Systems. (Reserved)

7.3.3.9 Pharmacy. (Reserved)

7.3.3.10 Material Management Information Systems. (Reserved)

7.3.3.11 Electronic Medical Records and Dictation Systems. (Reserved)

7.3.3.12 Medical Imaging Systems. (Reserved)

7.3.3.13 Archiving Systems. (Reserved)

7.3.4 Security Systems.

7.3.4.1 IP Security Cameras Systems. (Reserved)

7.3.4.2 Digital Video Recording. (Reserved)

7.3.4.3 Intrusion Detection Systems. (Reserved)

7.3.4.4 Site-Wide Monitoring. (Reserved)

7.3.4.5 Access Control Systems. (Reserved)

7.3.4.6 ID Badging Systems Integrated with Point of Sales Systems. (Reserved)

7.3.4.7 Threat Protection Systems. (Reserved)

7.3.4.8 Parking Access Systems. (Reserved)

7.4 Category 2 Systems.

7.4.1 Information Technology and Communications Systems Infrastructure.

7.4.1.1 Requirements for information technology and communications systems infrastructure shall be in accordance with 7.3.1, except as specified in 7.4.1.1.1 and 7.4.1.1.2.

7.4.1.1.1 HVAC systems serving the TEF, the TER, and TRs shall be connected to the essential electrical system.

7.4.1.1.2 Redundant pathways and cabling for the backbone distribution system shall not be required.

7.4.2 Voice, Data, Communications, and Cable Television Systems.

7.4.2.1 Voice/Telecommunications. (Reserved)

7.4.2.2 Local Area Networks (LANS). (Reserved)

7.4.2.3 Wireless LAN Systems and Public Wifi Hot Spots. (Reserved)

7.4.2.4 Wireless Voice Systems and In-Building Cellular Networks. (Reserved)

7.4.2.5 Cable Television. (Reserved)

7.4.3 Other Communications Systems.

7.4.3.1 Nurse Call Systems.
7.4.3.1.1 General. The nurse call system shall communicate patient and staff calls for assistance and information in health care facilities. The nurse call system shall be the audiovisual or visual type (using light and tone signals only to communicate calls) and shall be listed for the purpose.  
7.4.3.1.1.1 The nurse call system shall provide for communication of patient and staff calls for assistance, medical device alarms, and patient safety and security alarms.  
7.4.3.1.1.2 Supplemental features shall be permitted to be included, such as call initiation to alphanumeric pagers and other wireless devices carried by health care facility staff.  
7.4.3.1.2 Patient Area Call Station.  
7.4.3.1.2.1 Each patient bed location shall be provided with a calling device.  
7.4.3.1.2.2 No more than two calling devices, serving adjacent beds, shall be served by a single call station.  
7.4.3.1.3 Signals. Activation of a patient bed calling device shall cause visual signal activation in the corridor at the patient room door, the associated nursing station, the calling station, and associated nursing unit support areas, including medication, nourishment, charting, storage, and exam/treatment rooms, and clean and soiled linen storage areas.  
7.4.3.1.4 Additional visual signals shall be provided at corridor intersections where individual patient door signals are not directly visible from the central nursing station.  
7.4.3.1.5 Emergency Call. Each calling station shall be capable of an initiating emergency signal activation of a visual and audible emergency signal, distinct from the regular nurse call signal, that can be turned off only at that station. The emergency call shall activate an annunciator at the nearest associated nursing station, a visual signal in the corridor at the patient room door, and other locations as directed by the facility.  
7.4.3.1.5.1 Life safety and critical branches calling devices shall be provided at each inpatient toilet, bath, shower, or sitz bath, accessible to a patient lying on the floor. A pull cord shall be permitted to be used for this access.  
7.4.3.1.5.2 Life safety and critical branches calling devices shall be provided in outpatient and treatment areas where patients can be incapacitated.  
7.4.3.1.5.3 Life safety and critical branches calling devices shall be provided in patient toilet rooms in imaging suites, renal dialysis units, and similar areas.  
7.4.3.1.6 Staff Emergency Assistance Call.  
7.4.3.1.6.1 An emergency assistance system for staff to summon additional assistance shall be provided in each outpatient surgery, admission and discharge areas, and areas for psychiatric patients, including seclusion and security rooms, anterooms and toilet rooms serving them, communal toilet and bathing facility rooms, and dining, activity, therapy, exam, and treatment rooms.  
7.4.3.1.6.2 Other communications systems that perform the same function shall be permitted.  
7.4.3.1.7 A nurse call system shall be provided for geriatric, Alzheimer’s, and other dementia units, but all hardware shall have tamper-resistant fasteners, provisions shall be made for removal or covering of call button outlets, and call cords or strings in excess of 15.24 cm (6 in.) shall not be permitted.  
7.4.3.1.8 A nurse call system is not required in psychiatric units, but if one is included, all hardware shall have tamper-resistant fasteners, provisions shall be made for removal or covering of call button outlets, and control to limit unauthorized use is permitted.  
7.4.3.1.9 The staff emergency assistance system shall annunciate each call visibly and audibly in the clean workroom in the soiled workroom; in medication, charting, clean linen storage, nourishment, equipment storage, and examination/treatment rooms if provided; and at the nursing station of the associated nursing unit, with backup to another staffed area from which assistance can be summoned.  
7.4.3.3 Patient Tracking. (Reserved)  
7.4.3.4 Equipment and Asset Tracking. (Reserved)  
7.4.3.5 Staff and Visitor Tracking. (Reserved)  
7.4.3.6 Wireless Phone and Paging Integration. (Reserved)  
7.4.3.7 Patient and Equipment Monitoring Systems. (Reserved)  
7.4.3.8 Material Management Information Systems. (Reserved)  
7.4.3.9 Electronic Medical Records and Dictation Systems. (Reserved)  
7.4.3.10 Medical Imaging Systems. (Reserved)  
7.4.3.11 Archiving Systems. (Reserved)  
7.4.4 Security Systems.  
7.4.4.1 IP Security Cameras Systems. (Reserved)  
7.4.4.2 Digital Video Recording. (Reserved)  
7.4.4.3 Intrusion Detection Systems. (Reserved)  
7.4.4.4 Site-Wide Monitoring. (Reserved)  
7.4.4.5 Access Control Systems. (Reserved)
7.4.4.6 ID Badging Systems Integrated with Point of Sales Systems. (Reserved)
7.4.4.7 Threat Protection Systems. (Reserved)
7.4.4.8 Parking Access Systems. (Reserved)
7.5 Category 3 Systems.
7.5.1 Information Technology and Communications Systems Infrastructure.
7.5.1.1 Requirements for information technology and communications systems infrastructure shall be in accordance with 7.3.1, with exceptions as noted in 7.5.1.1.1 through 7.5.1.1.4.
7.5.1.1.1 Dual service entrance pathways into the EF are not required.
7.5.1.1.2 Power circuits serving equipment in the EF, the TER, and TRs shall not be required to be connected to the essential electrical system.
7.5.1.1.3 HVAC systems serving the EF, the ER, and TRs shall not be required to be connected to the essential electrical system.
7.5.1.1.4 Redundant pathways and cabling for the backbone distribution system shall not be required.
7.5.2 Voice, Data, Communications, and Cable Television Systems.
7.5.2.1 Voice/Telecommunications. (Reserved)
7.5.2.2 Local Area Networks (LANS). (Reserved)
7.5.2.3 Cable Television. (Reserved)
7.5.3 Other Communications Systems.
7.5.3.1 Nurse Call Systems. (Reserved)
7.5.3.2 Electronic Medical Records and Dictation Systems. (Reserved)
7.5.3.3 Medical Imaging Systems. (Reserved)
7.5.3.4 Archiving Systems. (Reserved)
7.5.4 Security Systems.
7.5.4.1 IP Security Cameras Systems. (Reserved)
7.5.4.2 Digital Video Recording. (Reserved)
7.5.4.3 Intrusion Detection Systems. (Reserved)
7.5.4.4 Access Control Systems. (Reserved)

A.7.1 Additional information on these systems can be found in IEEE 602, title, and Guidelines for Design and Construction of Health Care Facilities.
A.7.3.1.2 Additional information can be found in EIA/TIA 569-B.
A.7.3.1.2.1.3(B) Off-site electronic storage of patient records should also be considered.
A.7.3.1.2.1.5(B) Supplying the circuits serving equipment in the telecommunications entrance facility through an uninterrupted power system (UPS) provides a desirable level of redundancy.
A.7.3.1.2.1.6(C) Consideration should be given to the reliability of power supply to the HVAC equipment because of its important function within the telecommunications entrance facility.
A.7.3.1.2.2.2 In combined spaces, care must be taken to provide separation of and adequate service access for service provider equipment.

Substantiation: The committee is responding to the direction of the Technical Correlating Committee to develop a new chapter on low-voltage (signaling and communications) systems.
Committee Meeting Action: Accept
Recommendation:  
1. Revise the second sentence in 13.4.1.2.6.1(E) to read: 
   Testing shall be in accordance with 4.3.4.2 13.4.1.2.6.9.
2. Insert new 13.4.1.2.6.9 to read:
   13.4.1.2.6.9 Testing of battery-powered emergency lighting units.
3. Revise 13.4.1.2.6.1(E) to include the testing requirements of NFPA 101. (See Proposal 99-453 from Report of NFPA 99 in ROP for NFPA 2004 Fall Meeting for wording to be inserted)

Substantiation:  
1. Incorrect reference. 4.3.4.2 covers record keeping.
2. Text from Proposal 99-453 in Report on Proposals for NFPA 2004 Fall Meeting was supposed to be incorporated into NFPA 99-2005.

Committee Meeting Action:  Reject

Committee Statement:  This chapter is being deleted.

Recommendation:  
Add the following new sentence:
   Lighting level shall be not less than 3 foot-candles.

Substantiation:  
Current text does not list a minimum light level. 3 FC is listed in Illuminating Engineering Society of North American Guidelines as "temporary light to move about a room." However, this level may not be acceptable for anesthetizing location environment. Therefore, Technical Committee might want to make some measurements in conjunction with anesthesiologists and surgeons as to lighting levels they can accept in an emergency.

Committee Meeting Action:  Reject

Committee Statement:  This chapter is being deleted.
Revise 13.4.1.2.6.1(E) to read as follows (changes underlined):

(E) Battery-Powered Emergency Lighting Units.

1. One or more battery-powered emergency lighting units shall be provided within each operating room, as required in Section 700.12(E) of NFPA 70, National Electrical Code.

2. The lighting level of each unit shall be sufficient to terminate procedures intended to be performed within the operating room.

3. The sensor for such units shall be wired to the branch circuit(s) serving general area lighting within the operating room.

4. Units shall be capable of providing lighting for 1 and 1/2 hours.

5. Testing shall be in accordance with 4.3.4.2.

Substantiation:

1. Current wording is being misinterpreted. Emergency lighting unit was intended to operate whenever power to general lighting within an operating room was interrupted for any reason. Reference to Article 700 is not correct as these battery-powered emergency lights are not part of the essential electrical system in Chapter 4 of NFPA, nor part of an emergency system as described in Article 700 of NFPA 70.

2. No minimum lighting level criteria is included in current text.

3. & 4. Editorial. Clarify which circuits are to be monitored. Indicate how long a unit is to provide lighting (per proposal 99-453 for 2005 edition of NFPA 99).

Committee Meeting Action: Reject

Committee Statement: This chapter is being deleted.
This chapter establishes the minimum space, environmental, pathway and reliability requirements for an acute care hospital facility's technology and medical communication systems. Today's healthcare facilities rely on data, voice and other medical communication technologies and are now dependent on these systems to provide patient care. These systems are a "life critical", essential utility for hospitals. Technology and medical communication systems include data and voice communications, patient monitoring and alarms, nurse call, hospital information systems, digital imaging systems (PACS), security, building automation, fire and life safety, and telemedicine/teleconferencing, and the list continues to grow. The convergence of these systems continues to increase the demand and need for well designed systems and adequate space to accommodate these systems. The small communications "closets" of the past no longer support the systems and equipment required in healthcare today, not to mention what will be required in future systems.

This is not original material; its reference/source is as follows:
I am proposing this revision on behalf of the ASHE Technology Workgroup chaired by Mike Severns
Committee Meeting Action: Accept in Principle
Committee Statement: See action on Committee Proposal 99-380 (Log #CP328).

This additional information will give clarity to Tamper Resistance Receptacle and Shock Fault Circuit Interrupter application.

This is not original material; its reference/source is as follows:
NEMA; Tamper Resistance Receptacle information; OFI Inc.; SFCI information
Committee Meeting Action: Reject
Committee Statement: Shock fault circuit interrupters has no listing requirements. There is no evidence of a problem and unproven technology.
Proposed New Chapter for NFPA 99

Information Technology and Medical Communications Systems Requirements for Healthcare Facilities

Draft Proposal - November 17, 2006

NFPA 99 Technology Chapter

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1. Scope and Introduction

This chapter establishes the minimum space, environmental, pathway and reliability requirements for an acute care hospital facility’s technology and medical communication systems. Today’s healthcare facilities rely on data, voice and other medical communication technologies and are now dependent on these systems to provide patient care. These systems are a “life critical,” essential utility for hospitals.

Technology and medical communication systems include data and voice communications, patient monitoring and alarms, nurse call, hospital information systems, digital imaging systems (PACS), security, building automation, fire and life safety, and telemedicine/teleconferencing, and the list continues to grow.

The convergence of these systems continues to increase the demand and need for well designed systems and adequate space to accommodate these systems. The small communications “closets” of the past no longer support the systems and equipment required in healthcare today, not to mention what will be required in future systems.

2. Terms and Definitions

2.1 TDR – Technology Distribution Room

Technology distribution rooms (TDRs), also known as IDF, provide a secure, flexible, and easily managed location for the structured wiring systems, network electronics, clinical systems, nurse call systems and other equipment throughout the building.

2.2 TEC – Technology Equipment Center

This is the medical facility’s primary technology equipment room, also known as an MDF, and may additionally function as a data center if a remote data center is not being used.

2.3 BICSI – Building Industry Consulting Service International
BICSI is a telecommunications association whose goal is to provide the most technologically advanced Information Transport System (ITS) knowledge to the industry. In this effort, BICSI has created the Telecommunications Distribution Methods Manual (TDMM) as a reference for consultants, installers, owners, and manufactures. To help ensure proper installation of equipment to meet the standards relevant to the telecommunications industry, BICSI has created a Telecommunications Contractor Installation Manual (TCIM). BICSI is also the association that offers the Registered Communication Distribution Designer (RCDD) certification.

### 2.4 TIA – Telecommunication Industry Association

The TIA/EIA Standards are updated every five years. Due to the rapid changes in the telecommunications and electronics industries, TIA/EIA publishes periodic Telecommunications Systems Bulletins (TSB), which provide additional guidance on certain technical issues that must be addressed prior to the next scheduled revision of the standards. The information contained in TSBs is usually incorporated into the applicable standard during the next standards revision. Standards and publications are adopted by TIA/EIA in accordance with American National Standards Institute (ANSI) patent policy.

### 2.5 UPS – Uninterruptible Power Supply

An uninterruptible power supply (UPS) is a device that allows network equipment or computers to keep running for at least a short time when the primary power source is lost. It also provides protection from power surges. A UPS contains a battery that supplies power to the network equipment computers when the UPS senses a loss of power from the primary source. The UPS may have the ability to notify a user of the power loss, giving the user time to shutdown equipment or save any data and exit gracefully before the secondary power source (the battery) runs out. When power surges occur, a UPS intercepts the surge so that it doesn't damage network equipment or computers.

### 2.6 PACS – Picture Archive Communication System (PACS)

A system used by the radiology and diagnostic imaging industry to manage information and diagnostic images electronically.

### 2.7 EMI – Electromagnetic interference

Radiated or conducted electromagnetic energy that disrupts the operation or performance of another device or has undesirable effects on electronic equipment or signal transmissions. EMI is produced by many sources commonly found in a health care environment, including fluorescent lights, photocopiers, imaging equipment, motors (such as those used in elevators), etc.
2.8 **TSER – Telecommunications Service Entrance Room(s)**

The telecommunications service entrance room provides the point at which outdoor cabling interfaces with the building infrastructure. This area is also referred to as the demarc, or point of demarcation. Service providers, campus infrastructure, metropolitan area network (MAN) and wide area network (WAN) connections can be terminated in this space.

2.9 **Tele-duct**

The term tele-duct is a conceptual or visual representation of the cable tray clearances required in the main corridors. Tele-duct is used to correlate the clearance needs of the communication cable tray to that of large HVAC duct. A cable tray, depending on size, also requires these vertical clearances for access to the tray during and following construction.

2.10 **Tele-vator**

The term tele-vator is a conceptual or visual representation of the “stackable” characteristics necessary for the inherent function of the TDRs. If the TDRs are thought of as “communications elevators,” much of the cost and coordination issues associated with “un-stacked” TDRs can be avoided, eliminating the architectural re-design that is common in the SD/DD phases of design.

3. **Telecommunication Service Entrance Room (TSER)**

3.1 **General Description**

The TSER provides the point at which outdoor cabling interfaces with the building infrastructure. It is the location where the data and voice circuits and services enter the facility. This location may sometimes be combined with the Technology Equipment Center.

This room is critical to the hospital’s voice and wide area network connectivity. Diversity and redundancy of pathways into this location are required.

Consideration shall be given to facility, occupant, and user telecommunications wireline and wireless connectivity needs. Where access to both wireline and wireless services is required, the entrance facilities may require an upward adjustment in size, quantity, and location from the minimums stated below.

Coordination with each service provider is required throughout the design, procurement, and installation of telecommunications services to ensure that adequate space, cooling, and electrical requirements are met.
3.2 Minimum Number

3.2.1 Each hospital shall have at least one TSER that meets all of the requirements of this section.

3.2.2 In a hospital where the primary data center is located remotely, two TSERs and redundant telecommunications service entrances shall be provided.

3.2.3 In a hospital where the primary data center is co-located with the hospital and remote WAN connectivity is not required between the primary data center and the hospital, a single TSER is acceptable. However, if in this circumstance the subject primary data center also serves other remote hospital locations, then two TSERs are required.

3.3 Minimum Size

3.3.1 The TSER may be co-located with the TEC if desired. If the TSER will be combined with the TEC, then 150 square feet shall be added to the TEC to accommodate the telecommunications service entrance equipment. All other minimum requirements apply.

3.3.2 If the TSER is separate from the TEC then it shall be a minimum of 12′ ×14′.

3.4 Location Requirements and Restrictions

3.4.1 The TSER shall be dedicated to the telecommunications function and related support facilities.

3.4.1.1 Electrical equipment or fixtures (e.g., transformers, panel boards, conduit, wiring, etc.) that are not directly related to the support of the TSER shall not be installed in, pass through, or enter the TSER.

3.4.1.2 Mechanical equipment and fixtures (e.g., water or drainage piping of any kind, ductwork, pneumatic tubing, etc.) that are not directly related to the support of the TSER shall not be installed in, pass through, or enter the TSER.

3.4.2 The location of other underground utilities, such as electrical, water, gas, and sewer, shall be considered in the selection of the TSER location and avoided.

3.4.3 The TSER shall be located a minimum of 12 feet from any transformer, motors, x-ray, induction heaters, arc welders, radio and radar systems, or other sources of electromagnetic interference.
3.4.4 The TSER shall be located in a dry area not subject to flooding and shall be as close as practicable to the building entrance point and next to the electrical service room in order to reduce the length of bonding conductor to the electrical grounding system. The wireless transmission or reception entrance room shall be located as close as practicable to the wireless transmission or reception field.

3.4.4.1 If the facility is a multi-story structure, the TSER shall be located directly below the stacked TDRs, if possible.

3.4.2.2 A floor drain shall be provided within the space if risk of water ingress exists.

3.5 Security

3.5.1 Access to the TSER shall be restricted and controlled by an access control system with auditing capabilities to provide knowledge of who has entered the TSER and when this entry has occurred.

3.6 Power Requirements

3.6.1 All circuits serving the TSER and the equipment within the TSER shall be dedicated to serving the TSER and shall be connected to the hospital’s emergency power system.

3.6.2 All equipment within the TSER shall be served by UPS power.

3.7 Grounding

3.7.1 Telecommunication systems need grounding, bonding, and electrical protection to ensure optimized performance of the telecommunication systems.

3.7.2 All grounding, bonding, and electrical protection shall meet the requirements of NEC and J-STD-607, latest version. Solid copper grounding bus bars, referred to as Telecommunication Ground Bus bar (TGB), (typically ¼” thick, 4” high with a variable length, depending on the amount of equipment to be grounded) shall be installed in the TSER. The ground bar shall be drilled with holes according to NEMA standard, to accommodate bolted compression fittings. All racks, cabinets, sections of cable tray, and metal components of the technology system that do not carry electrical current shall be grounded to this bus bar. Bus bars shall be connected by a backbone of insulated, #6 (minimum) to 3/0 AWG stranded copper cable between all technology rooms, and connected back to the Telecommunications Main Grounding Bus bar (TGMB) in the TSER. The main grounding bar shall then be connected back to the building main electrical service ground. Do not bond the TGMB to...
anything other than the building main electrical service ground. Bonding conductor cabling shall be colored green or labeled appropriately.

3.7.3 All inter-building copper backbone cable that contains metallic shielding must have the shield bonded to the Telecommunications Main Ground Bus bar.

3.7.4 All intra-building copper backbone cable that contains metallic shielding must have the shield bonded to the Telecommunications Ground Bus bar.

3.7.5 All inter-building copper backbone cables that are installed, underground or aerial, shall be equipped with building entrance protection, terminated within 50 feet of entering the building, and contain heat coils for sneak current protection. Each pair of the copper cables shall be terminated on the protector block, and each grounding lug of the protector blocks shall be bonded to the TMGB.

3.8 Environmental Requirements

3.8.1 Temperature and humidity in the TSER shall be controlled to the operating range of 18 to 24 degrees C (64 to 75 degrees F) with 30% to 55% relative humidity. Humidification and dehumidification equipment may be required depending upon local environmental conditions.

3.8.1 The ambient temperature and humidity shall be measured at a distance of 1.5 m (5 ft) above the floor level, after the equipment is in operation, at any point along an equipment aisle center line.

3.8.2 Reliable cooling and heating shall be provided on a 24 hours-per-day, 365 days-per-year basis. Any HVAC systems serving the TSER shall be connected to the hospital’s emergency power systems.

3.9 Fire Suppression Systems

3.9.1 If sprinklers are required within the TSER, the heads shall be provided with wire cages or shall be recessed to prevent accidental operation.

3.9.2 Drainage troughs shall be placed under all the sprinkler pipes to prevent leakage onto the connecting hardware/equipment within the space.

3.9.3 A dry pipe, pre-action, fire suppression system is recommended in all TSER spaces.

3.10 Other Minimum Requirements
3.10.1 Floors, walls, and ceiling shall be treated to eliminate dust. Finishes shall be light in color to enhance room lighting. Floors shall have anti-static properties.

3.10.2 A minimum of one wall shall be covered with 19 mm (¾ in.) plywood, 2.4 m (8 ft) high. Plywood shall be securely fastened to the wall. Plywood shall be fire-rated (fire retardant) to meet applicable codes.

3.10.3 Lighting shall be a minimum of 500 lx (50 foot-candles) measured 1 m (3 ft) above the finished floor, in the middle of all aisles between cabinets and racks.

3.10.3.1 The lighting shall be controlled by one or more switches located near the entrance door(s) to the room.

3.10.3.2 Emergency lighting and signs shall be properly placed per AHJ, such that an absence of primary lighting will not hamper emergency exit.

3.10.3.3 Lighting fixtures shall not be powered from the same electrical distribution panel as the telecommunications equipment in the entrance room or space.

3.10.3.4 Dimmer switches shall not be used.

3.10.4 The minimum clear height in the room shall 4 m (12 ft) without obstructions.

4. Technology Equipment Center (TEC)

4.1 General Description

The Technology Equipment Center or TEC is the heart of the information and technology and communications systems for the hospital. Sometimes referred to as a MDF, the TEC must be a sufficiently sized, environmentally controlled, power conditioned, fire protected, secure space with limited access, located strategically to avoid any flood plain or other known hazard.

The TEC houses the main networking equipment and may also house application servers and data storage devices that serve the hospital if the TEC is being utilized as a data center. Today’s modern hospital cannot function without the equipment contained in the TEC.

The TEC shall be a separate space and shall not used for any other purposes besides data storage, processing, and networking. The TEC is connected to the TSER and a series of TDRs or Technology Distribution Rooms. The TSER may be combined with the TEC space if desired.
The hospital TEC may be dedicated to the hospital where it is located, serve an entire hospital campus, or serve multiple hospital campuses. Each of these different strategies is acceptable, and each places different requirements on the TEC.

4.2 Minimum Number

4.2.1 Each hospital shall have at least one TEC space that meets the minimum requirements of this section.

4.2.2 Hospitals are strongly encouraged to develop disaster recovery plans and to consider the need for a second TEC to help meet their disaster recovery needs if no other option exists.

4.2 Minimum size

4.3.1 If the TEC serves as the hospital’s primary data center, the minimum size shall be 24’ × 40’.

4.3.2 If the hospital is served by a remote data center connected by a wide area network connection, the minimum size shall be 20’ × 15’.

4.3.3 These size requirements are minimums. The actual size requirements for a TEC space can be dramatically larger and can be difficult to determine, particularly if the contents of the rooms have not been clearly defined. In all cases, it is imperative that the TEC be of adequate size to provide proper space to meet service requirements for the equipment that will be housed there at both the time of construction and in the future.

4.4 Location Requirements and Restrictions

4.4.1 The Technology Equipment Center (TEC) shall be a space dedicated exclusively for the purposes of data storage, data processing, and networking.

4.4.1.1 Electrical equipment or fixtures (e.g., transformers, panel boards, conduit, wiring, etc.) that are not directly related to the support of the TEC shall not be installed in, pass through, or enter the TEC.

4.4.1.2 Any mechanical equipment or fixtures (e.g., water or drainage piping of any kind, ductwork, pneumatic tubing) not directly related to the support of the TEC shall not be installed in, pass through, or enter the TEC.

4.4.1.3 The TSER may be combined with the TEC space if desired. (See requirements in Section 3.)
4.2.2 The TEC shall be located in a low-traffic, non-public, non-sterile area of the facility that can be easily and effectively secured.

4.4.3 The TEC shall be located above any flood plains and below the top level of the facility to deter water damage to the equipment from outside sources (e.g., leaks from the roof or flood damage).

4.4.4 In areas prone to hurricanes or tornados, the TEC shall be located away from exterior curtain walls to prevent wind and water damage.

4.4.5 The TEC shall be located a minimum of 12 feet from any transformer, motors, x-ray, induction heaters, arc welders, radio and radar systems, or other sources of electromagnetic interference.

4.4.6 The TEC shall be located or designed to avoid vibration from mechanical equipment or other sources.

4.4.7 Locations that are restricted by building components that limit future expansion such as elevators, building structural elements, kitchens, central energy plants, outside walls, or other fixed building walls shall be avoided. Accessibility for the delivery of supplies and equipment to the space should be provided.

4.5 Security

4.5.1 Access to the TEC shall be restricted and controlled by an access control system with auditing capabilities to provide knowledge of who has entered the TSER and when this entry has occurred.

4.6 Power Requirements

4.6.1 All circuits serving the TEC and the equipment within the TEC shall be dedicated to serving the TEC.

4.6.2 All circuits serving the TEC shall be connected to the hospital’s emergency power system.

4.6.3 All computer and networking equipment within the TEC shall be served by UPS power.

4.7 Grounding

4.7.1 All grounding, bonding, and electrical protection shall meet the requirements of NEC and J-STD-607, latest version. Solid copper grounding bus bars, referred to as Telecommunication Ground Bus bar (TGB), (typically ¼” thick, 4” high with a variable length depending on the amount of equipment to be grounded) shall be installed in the TEC. The ground bar shall be drilled with holes according to NEMA standard.
to accommodate bolted compression fitting. All racks, cabinets, sections of cable tray, and metal components of the technology system that do not carry electrical current shall be grounded to this bus bar. Bus bars shall be connected by a backbone of insulated, #6 (minimum) to 3/0 AWG stranded copper cable between all TDRs, and connected back to the Telecommunications Main Grounding Bus bar (TGMB) in the TSER. The main grounding bar shall then be connected back to the building main electrical service ground. Do not bond the TGMB to anything other than the building main electrical service ground. Bonding conductor cabling shall be colored green or labeled appropriately.

4.8 Environmental Requirements

4.8.1 Temperature and humidity in the TEC shall be controlled to an operating range of 18 to 24 degrees C (64 to 75 degrees F) with 30% to 55% relative humidity. Humidification and dehumidification equipment may be required depending upon local environmental conditions.

4.8.2 The ambient temperature and humidity shall be measured at a distance of 1.5 m (5 ft) above the floor level, after the equipment is in operation, at any point along an equipment aisle center line.

4.8.3 Reliable cooling and heating shall be provided on a 24 hours-per-day, 365 days-per-year basis. Any HVAC systems serving the TEC shall be connected to the hospital’s emergency power systems.

4.8.4 A positive pressure differential with respect to surrounding areas shall be provided.

4.9 Fire Suppression Systems

4.9.1 A fire suppression system specifically designed for data center applications is required in the TEC.

4.9.2 As a minimum the fire suppression system shall be a dry pipe, pre-action, fire suppression system. No wet pipe sprinkler systems shall be allowed in the TEC.

4.9.2.1 All sprinkler heads shall be provided with wire cages to prevent accidental discharge.

4.9.3 A gaseous fire suppression system is acceptable.

4.10 Other Minimum Requirements

4.10.1 No printers are to be located in the TEC, and staff shall have separate work locations outside of the TEC.
4.10.2 Floors, walls, and ceiling shall be treated to eliminate dust. Finishes shall be light in color to enhance room lighting. Floors shall have anti-static properties.

4.10.3 Lighting shall be a minimum of 500 lx (50 foot-candles) measured 1 m (3 ft) above the finished floor, in the middle of all aisles between cabinets and racks.

4.10.3.1 The lighting shall be controlled by one or more switches located near the entrance door(s) to the room.

4.10.3.2 Emergency lighting and signs shall be properly placed per AHJ, such that an absence of primary lighting will not hamper emergency exit.

4.10.3.3 Lighting fixtures shall not be powered from the same electrical distribution panel as the equipment in the TEC.

4.10.3.4 Dimmer switches shall not be used.

4.10.4 The minimum clear height in the room shall 4 m (12 ft) without obstructions.

5. Technology Distribution Rooms (TDR)

5.1 General description

Technology distribution rooms (TDR) provide a secure, flexible, and easily managed location for the structured wiring systems, network electronics, clinical systems, nurse call systems and other technology and communications equipment throughout the building. Each TDR is then connected back to the TEC to provide a building wide network and communications system.

TDRs house a variety of technology systems and system components. Typical systems and equipment located in TDRs include the following:

- Data network and voice communication equipment and cabling
- Fire alarm system components
- Building automation system (BAS) components and equipment
- Security components and associated equipment/CCTV
- Nurse call system components and equipment
- Distributed antenna system (DAS) components and equipment
- Music and video entertainment components and equipment
- Paging equipment
- Medical gas monitoring equipment
- Lighting control panels
- CATV components and equipment
- Patient and equipment tracking systems equipment and components
- Smart OR/IT and video switching equipment
- Physiological monitoring and medical telemetry components and equipment
- Audio visual systems and components
- Telemedicine
- PACS
- Cellular amplification systems
- Digital signage system components

5.2 Minimum Number of TDRs

5.2.1 TDRs shall be provided throughout the facility as required to meet the 90 m (292 feet) maximum pathway distance requirements for Ethernet cables from the termination point in the TDR to each wall outlet.

5.2.2 There shall be a minimum of one TDR on each floor of the facility.

5.2.3 A TDR may serve a maximum of 20,000 square feet of useable space on a single floor.

5.3 Minimum size

5.3.1 All TDRs shall be have a minimum inside dimension of 12’ × 14.’

5.3.2 Each TDR shall contain space for a minimum of 4 standard equipment racks, as well as wall-mounted components.

5.3.3 A 12’ × 16’ inside dimension is recommended for TDRs. A TDR of this size will allow for future growth and the potential for an additional row of equipment racks.

5.4 Location Requirements and Restrictions

5.4.1 The TDR shall be a space dedicated exclusively for the purposes of supporting the technology and communications infrastructure and systems such as those listed above.

5.4.1.1 Electrical equipment or fixtures (e.g., transformers, panel boards, conduit, wiring, etc.) that are not directly related to the support of the TDR shall not be installed in, pass through, or enter the TDR.

5.4.1.2 Any mechanical equipment or fixtures (e.g., water or drainage piping of any kind, ductwork, pneumatic tubing) not directly related to the support of the TDR shall not be installed in, pass through, or enter the TDR.
5.4.2 TDRs shall be located as close as practicable to the center of the area served and preferably in the core area. The TDR shall be located in an accessible, non-sterile area on each floor. Access shall be directly off a corridor. Access to a TDR shall not be through another space, such as an electrical room or mechanical room.

5.4.3 TDRs must be stacked vertically in a multi-story facility such that the entire footprint of the TDR is directly above or below the TDRs on other floors.

5.4.4 The TEC shall be located a minimum of 12 feet from any transformer, motors, x-ray, induction heaters, arc welders, radio and radar systems, or other sources of electromagnetic interference.

5.4.5 TDRs should be located to avoid large ducts, beams, and other building elements that may interfere with proper cable routing and may limit future access to the cable tray and cabling.

5.5 Security

5.5.1 Access to the TDR shall be restricted and controlled by an access control system with auditing capabilities to provide knowledge of who has entered the TSER and when this entry has occurred.

5.6 Power

5.6.1 All circuits serving the TDR and the equipment within the TDR shall be dedicated to serving the TDR.

5.6.2 All circuits serving the TDR shall be connected to the hospital’s emergency power system.

5.6.3 All computer, networking, and clinical equipment and systems within the TDR shall be served by UPS power.

5.7 Grounding

5.7.1 All grounding, bonding, and electrical protection shall meet the requirements of NEC and J-STD-607, latest version. Solid copper grounding bus bars, referred to as Telecommunication Ground Bus bar (TGB), (typically ¼” thick, 4” high with a variable length depending on the amount of equipment to be grounded) shall be installed in the TDR. The ground bar shall be drilled with holes according to NEMA standard, to accommodate bolted compression fitting. All racks, cabinets, sections of cable tray, and metal components of the technology system that do not carry electrical current, shall be grounded to this bus bar. Bus bars shall be connected by a backbone of insulated, #6 (minimum) to 3/0 AWG stranded copper cable, between all technology rooms, and shall be
connected back to the Telecommunications Main Grounding Bus bar (TGMB) in the TSER. The main grounding bar shall then be connected back to the building main electrical service ground. The TGMB shall not be bonded to anything other than the building main electrical service ground. Bonding conductor cabling shall be colored green or labeled appropriately.

5.8 Environmental Requirements

5.8.1 Temperature and humidity in the TDR shall be controlled to an operating range of 18 to 24 degrees C (64 to 75 degrees F) with 30% to 55% relative humidity. Humidification and dehumidification equipment may be required depending upon local environmental conditions.

5.8.2 The ambient temperature and humidity shall be measured at a distance of 1.5 m (5 ft) above the floor level, after the equipment is in operation, at any point along an equipment aisle center line.

5.8.3 Reliable cooling and heating shall be provided on a 24 hours-per-day, 365 days-per-year basis. Any HVAC systems serving the TDR shall be connected to the hospital’s emergency power systems.

5.9 Fire Suppression Systems

5.9.1 If sprinklers are required within the TDR, the heads shall be provided with wire cages or shall be recessed to prevent accidental operation.

5.9.2 Drainage troughs shall be placed under all the sprinkler pipes to prevent leakage onto the connecting hardware/equipment within the space.

5.9.3 A dry pipe, pre-action, fire suppression system is recommended in all TDR spaces.

5.10 Other Minimum Requirements

5.10.1 The door shall open outward from TDR whenever possible.

5.10.2 Each wall shall be covered with 19 mm (¾ in.) plywood, 2.4 m (8 ft) high. Plywood shall be securely fastened to the wall. Plywood shall be fire-rated (fire retardant) to meet applicable codes.

5.10.3 Lighting shall be a minimum of 500 lx (50 foot-candles) measured 1 m (3 ft) above the finished floor, in the middle of all aisles between cabinets and racks.

5.10.3.1 The lighting shall be controlled by one or more switches located near the entrance door to the room.
5.10.3.2 Emergency lighting and signs shall be properly placed per AHJ, such that an absence of primary lighting will not hamper emergency exit.

5.10.3.3 Lighting fixtures shall not be powered from the same electrical distribution panel as the equipment in the TDR.

5.10.3.4 Dimmer switches shall not be used.

5.10.4 The minimum clear height in the room shall 4 m (12 ft) without obstructions.

6. Cabling Pathways and Raceway Requirements

6.1 General Description

Cable pathways and raceways are comprised of conduits, cable trays, core openings and underground conduit or duct bank for the routing of technology cabling into, between, and throughout the facility.

This section addresses pathway requirements for the routing of incoming outside service cabling, inter- and intra-building communications cables, backbone/riser cabling, and horizontal cabling from the TDR to user work stations.

6.2 Pathway Redundancy and Diversity

6.2.1 Multiple, diverse pathways shall be provided between the TSER, TEC and all TDRs.

6.2.2 Communications backbone cabling and communications interconnects shall be provided with physically separate paths separated by fire-rated barriers and independent riser. The goal of this requirement is to eliminate any single point of failure in the connections between the TSER, TEC, and TDRs throughout the facility.

6.3 Conduits

6.3.1 Conduits shall be provided for all backbone cabling routed horizontally through a building. For riser and plenum rated cables, conduit may be EMT conduit. For all other cases, cabling shall be rigid.

6.3.2 Conduits shall be sized so that initial fill capacities do not exceed 40% fill for any one conduit. Wherever multiple cable pulls are planned for one conduit, inner ducts shall be provided in order to facilitate future use of conduits not fully utilized. Spare conduits shall be provided to allow a minimum of 100% growth.
6.3.3 Conduits shall be provided for horizontal cabling over inaccessible ceilings.

6.3.4 Conduits shall be provided in open ceiling spaces, such as central plant locations, mechanical and electrical rooms, shipping and receiving areas, loading docks, etc.

6.3.5 Conduits for individual workstation drops shall be a minimum of 1” in diameter and in any case shall be sized to support the maximum capacity of cables the outlet/faceplate can support to a 40% fill capacity.

6.4 Cable tray

6.4.1 Cable tray support for horizontal cabling shall be used wherever multiple cables exceed 100 and ceilings are accessible.

6.4.2 Cable trays shall be sized for future cabling growth of 100%.

6.4.3 Cable trays shall not exceed 40% fill capacity for planned cabling.

6.4.4 Cable tray shall be run in as straight a line as possible, with a minimum of turns and offsets.

6.4.5 Straight sections of cable trays shall not be mounted above inaccessible ceilings where access to both sides of the cable tray exceeds 4 feet. Cable tray turns above inaccessible ceilings shall not be allowed. Instead, conduits shall be used for this purpose.

6.4.6 Cable tray shall incorporate radius turns in order to prevent violating minimum cable bend restrictions of cables routed in the cable tray.

6.4.7 Cable trays shall be mounted no higher than 24” above accessible ceilings. Recommended height above accessible ceilings is 12”.

6.4.7.1 Cable tray shall be mounted at a height above the accessible ceiling sufficient to provide a minimum 6” clearance from lights and electronic ballast.

6.4.7.2 Cable tray shall be accessible from at least (1) side with a minimum of an 18 in. wide by 48 in. long space on one side and 12 in. headroom clearance above the tray. See the cable tray clearance requirements sketch on page 24.

6.4.8 Loading and weight

6.4.8.1 Cable tray shall be designed to support the number of cables anticipated plus 100% growth.
6.4.8.2 Cable tray supports shall be provided for each individual section on both sides of splice or butt joints.

6.5 Ladder Rack

6.5.1 Ladder rack support shall be provided in TDR, TSER and TEC spaces for the support of horizontal cabling within the rooms.

6.5.2 Ladder rack shall be grounded in accordance with the NEC, TIA/EIA, and BICSI grounding requirements.

6.5.3 Ladder rack shall be appropriately sized to support the anticipated cabling plus 50% growth.

6.5.4 Ladder rack shall be supported on both sides of joints, splices and tees.

6.5.5 Ladder rack mounting height shall be accessible without a ladder. Mounting height in TDRs and TECs shall allow for radius drop control of cabling exiting the ladder rack vertically.

6.6 J-Hooks

6.6.1 J-hook supports may be used for support of horizontal cabling only wherever conduit or cable tray are not required. Backbone cabling and riser cabling shall be routed in conduits or cable tray.

6.6.2 J-hook supports shall not be spaced wider than 5’ maximum.

6.6.3 A J-hook shall not support more than 50 cables.

6.6.4 Cabling for different systems’ cable shall be supported by a separate J-hook and shall not be co-mingled in the same J-hook support.

6.6.5 Where multiple J-hooks are required to accommodate different systems’ cabling, J-hooks shall be mounted to the same threaded rod in lieu of separate J-hooks.

6.7 Floor/Wall Cores and Openings

6.7.1 Vertical cores shall be stacked in TDRs and other spaces with as few offsets as possible.

6.7.2 Cores shall be a minimum of 4” in diameter where openings are circular.

6.7.3 Rectangular openings shall be at least 3” on one side.

6.7.4 Core openings must maintain fire ratings of existing slabs/walls.

6.8 Backboxes
6.8.1 All technology wall outlets shall have backboxes.

6.8.2 Backboxes shall be double-gang, 4 11/16" × 4 11/16" × 2 1/2" with mud-rings to house a single gang faceplate unless otherwise noted or required by a system.

6.8.3 Backboxes shall provide for a minimum 1”, 1 1/4" is recommended, conduit connectivity.

7. Outside Plant Infrastructure (OSP)

7.1 General Description

Outside plant infrastructure consists of the conduits, vaults, and other pathways and cabling used to connect buildings on a campus and to provide services from off-campus service providers.

Outside plant connectivity can consist of aerial cabling (not recommended due to higher possibility of service disruptions), direct buried cabling, concrete-encased conduits, and/or tunnel services.

7.2 Redundant Pathways Required

7.2.1 A minimum of 2 telecommunications service entrance pathways shall be provided to the TSER.

7.2.2 All service entrance pathways shall be a minimum of 20 feet apart.

7.2.3 Service entrances that enter the site from different directions are highly recommended.

7.2.4 The facility shall have two means of access to the campus underground conduit system from within the facility.

7.3 Tunnels

7.3.1 Tunnels shall follow the guidelines listed below for vaults and conduits unless otherwise specified.

7.3.2 Cable trays may be used in tunnels in lieu of conduits, provided the tunnel has adequate access to pull cables.

7.3.3 Tunnels used for electrical and mechanical distribution can be shared with telecommunications infrastructure as long as adequate separation is provided.

7.4 Underground Conduits
7.4.1 Underground conduits shall be a minimum 4-inch conduit or duct constructed of PVC, type Schedule 40, with appropriate encasement.

7.4.2 Conduit fill ratio shall not exceed 40 percent.

7.4.3 Conduit quantity and size shall be determined based on the requirements of the initial installation plus 50% spare capacity above the initial installation requirements and known growth.

7.4.4 The minimum pathway into any new facility shall be four 4-inch conduits.

7.4.5 A minimum of two spare conduits shall be installed in addition to what is required.

7.5 Minimum Separation

7.5.1 Underground conduit for technology systems shall be placed a minimum of 12" from electrical conduit if earth is the only separation between conduits.

7.5.2 Twenty-four (24) inches of separation between communication conduits and steam pipes is necessary if they are crossing perpendicularly, and 6 ft of separation is necessary if they are running parallel.

7.6 Design and Installation

7.6.1 Conduit depth shall be a minimum of 24", with a preferred depth of 36", for all technology systems.

7.6.2 PVC conduit shall transition to Rigid Metallic conduit no less than 10 feet outside the building foundation.

7.6.3 Conduits passing through the exterior wall of a building shall be sealed watertight. To allow for proper sealing of service entrance penetrations, all wall sleeves must be sized to provide a minimum 1/2" clearance around the conduit.

7.6.4 No more than two 90 degree manufactured bends shall exist in any conduit run. If additional bends are required, a manhole or vault shall be installed to limit any single conduit run to no more than two 90 degree changes in direction.

7.6.4.1 No LB’s (elbows) are allowed in any conduit installation.

7.6.4.2 Conduit sweeps/bends shall be no less than 25-feet apart, except where the conduits enter the building.
7.6.5 All conduits shall be installed so that any water or fluids which may infiltrate the conduits shall flow away from the building, toward the manholes, avoiding any possibility of trapped fluids.

7.6.6 All conduits and inner duct shall be capped at both ends immediately upon installation to prevent the intrusion of rodents, water, and gases during and after the construction process. The contractor shall take all necessary precautions to ensure that dirt, trash, plaster, and other objects are not susceptible to clogging any conduit, innerduct, fittings, or boxes. Prior to pulling any wires, all conduits in concrete, floors, or in earth shall be inspected and cleansed of debris and moisture.

7.6.7 All OSP conduits shall have 1/4" polypropylene rope installed for pulling cables. A new 1/4" polypropylene rope shall be installed each time cables are run within the conduit.

7.6.8 All OSP innerduct shall have pull string installed. A new pull string shall be installed each time fiber is run within the conduit/innerduct.

7.6.9 All cable installed in OSP duct bank shall be installed in the lowest available conduit in a duct back, until maximum conduit fill ratio is met. Vaults shall be placed to allow cable spools direct access from work/reel trucks.

7.7 Vault/Manhole Requirements

7.7.1 Vaults shall be located a minimum of every 400 feet. The interior dimensions of the vault shall be at 6' wide × 8' long × 7' high. The vault cover shall be a minimum of 36" in diameter and cast with the word TELECOMMUNICATIONS along with the vault number assigned by the medical facility. All vault covers are to have recessed handles that pull out when needed for opening. Vaults shall not be adjacent to nor share any walls with electrical manholes.

7.7.2 Vaults must be equipped with a sump, corrosion-protected pulling iron, cable racks, grounded ladder and power/light conductors as required for telecommunications support per NEC requirements. All material used within a vault shall be resistant to corrosion. All vaults must have cast-iron steps for entry and exit.

7.7.3 All conduits entering a vault shall extend 4" into the vault and be clearly labeled. Any joints or splices within a vault must be watertight.

7.7.4 Cables entering a vault must have 10' of slack looped in the vault and be kept a minimum of 6" above vault floor. All cables must be labeled at both ends with the owner of the cable, cable number, cable type, pairs utilized, and termination point.
7.7.5 Provider/Owner Point of Entry – As a minimum, two 103 (4) trade size conduits, with at least two spare 103 (4) trade size conduits shall be placed for each entrance point. In addition, three 53 (2) trade size conduits shall be considered for placement at each entrance point.

8. Testing and Certification

8.1 Testing

Testing is crucial in assuring the overall integrity and performance of the cabling system.

8.2 Definitions

8.2.1 Cabling: all of the components of a passive cabling system: cable, connecting hardware, patch and equipment cords.

8.2.2 Channel: the total end to end passive cabling system between the work area and telecommunications room, including the equipment cords that will attach to active equipment at each end. This includes the telecommunications outlet/connector, cable, the patch panel and/or cross-connect, all patch and equipment cords, and an optional consolidation point or transition point.

8.2.3 Permanent Link: the passive cabling system between the telecommunications outlet/connector in the work area and the patch panel connector in the telecommunications room. This does not include any patch or equipment cords. This is typically the permanently installed cabling configuration that is tested and certified by the cabling installer.

8.3 Copper and Fiber Link Segments:

All copper permanent links and fiber link segments shall be tested in accordance with ANSI/TIA/EIA-568, latest revision.

Testing Procedures

All testing procedures shall comply with BICSI’s Telecommunications Distribution Methods Manual (TDMM), latest revision.

8.4 Test Results

All test results shall be documented in hard copy and/or soft copy.

8.5 Cabling Tests

All cabling shall be tested and certified before active equipment is connected.
8.7 Active System/Network Equipment

Information systems shall test each completed cabling link with active equipment, and document and certify results before turning over to users.

****Insert Artwork Here****

****Insert Artwork Here****
COMMUNICATIONS RESERVED SPACE

NOTES: AFF HEIGHT OF CABLE SHALL BE REACHABLE BY A PERSON STANDING AT THE 6-FOOT HEIGHT ON AN 8-FOOT LADDER. THAT PLACES THE MAXIMUM CABLE TRAY HEIGHT AT APPROXIMATELY 12-FOOT AFF TO THE TOP EDGE OF THE SIDE RAIL. THE SIDE RAIL HEIGHT MAY VARY.

SLEEVES

STATION CONDUIT FROM ADJACENT ROOM

STATION CONDUIT FROM ADJACENT ROOM

DETAIL NOTES:
▷ NO MORE THAN 4 FEET BETWEEN COMMUNICATIONS RESERVED ACCESS SPACES

CABLE TRAY CLEARANCE REQUIREMENTS

SCALE: NOT TO SCALE
Wet Locations. Routine housekeeping procedures and incidental spillage of liquids do not define a wet location.

Spillage of liquids in an anesthetizing location where surgery is performed shall be considered a wet location.

Substantiation: The modern operating room is filled with electronic life support equipment. This equipment is vital for the safe care of a patient during surgery and anesthesia. In addition, there are frequent instances of standing pools of saline, water, blood and urine on the floor. Also intravenous fluids frequently drip on electronic equipment. The surgeons use irrigating fluids in many procedures. These fluids often end up on the floor. Major surgical procedures, trauma and transplant surgery are associated with large amounts of blood loss. This blood can easily end up on the floor. The result is that modern operating rooms frequently have conductive fluids on the floor and this presents a hazard to OR personnel and patients. Most operating rooms also have hot air warmers for patients. These devices are often mounted on IV poles where fluids can drip on them. We recently had one of these devices short circuit and blow smoke into the operative field. Since the device was connected to an isolated power system, the line isolation monitor alerted all personnel to a problem, and limited the current flow probably preventing a fire. It is essential that modern operating rooms have the added protection of isolated power or at a minimum ground fault circuit interrupters. This would be accomplished by recognizing operating rooms as wet locations.

Committee Meeting Action: Reject

Committee Statement: The committee feels that incidental spillage does not necessarily constitute a wet location.

Tamper Resistance Receptacles use a mechanical electrically-insulating shutter system to shield from accessing live voltages at electrical receptacle outlets. Shock Fault Circuit Interrupters (SFCI) uses a relay to normally disconnect electricity at the receptacle outlet. SFCI only turns electricity on at the receptacle when it detects the insertion of an electrical plug with a RightPlug compliant tag. The SFCI only detects an ISO 14443B RFID tag with a RightPlug header. The RightPlug tag is designed to be embedded in a device plug or attached to the face of a device plug.

With the addition of the following text, there needs to be some explanation added to Annex A.

Receptacles shall not be required in areas where medical requirement mandate otherwise (e.g., certain psychiatric, pediatric, or hydrotherapy areas). Receptacles located within the rooms, bathrooms, playrooms, activity rooms, and patient care areas of pediatric wards shall be listed Tamper Resistant or shall be of the Shock Fault Circuit Interrupted (SFCI) type.

This additional information will give clarity to Tamper Resistance Receptacle and Shock Fault Circuit Interrupter application.

This is not original material; its reference/source is as follows:

National Electrical Manufacturers Assn. (NEMA); Tamper Resistant Receptacle information; UL standard in process: Shock Fault Circuit Interrupter (SFCI) specifications; www.rightplug.com; RightPlug tag information.

Committee Meeting Action: Reject
Committee Statement: Shock fault circuit interrupters has no listing requirements. There is no evidence of a problem and unproven technology.