Code-Compliant Power Systems in Operating Rooms

REGION 6
ASHE

YOUR SPEAKERS TODAY

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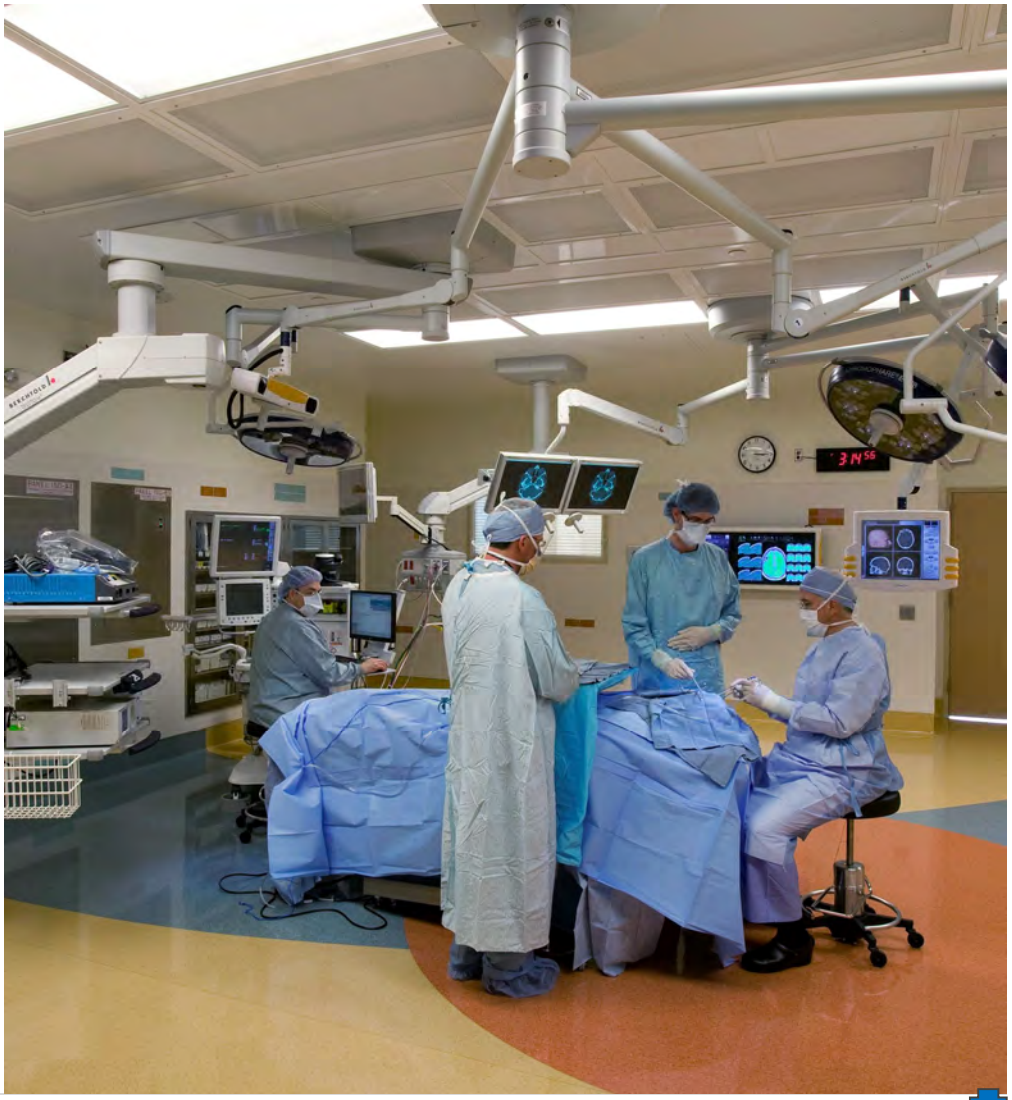
LEARNING OBJECTIVES – GET READY… THERE IS A LOT OF CONTENT HERE!

- Codes & Standards
- Design Process Basics
- Wet Procedure Location
- Special Protection
- Design Criteria
- Installation
- Testing and Commissioning

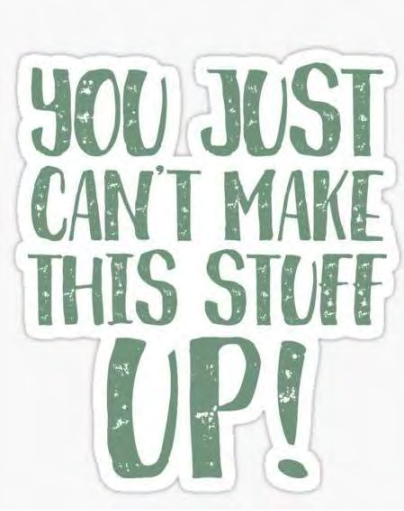
P.S. We know some slides are busy but we like to share code sections, standards, and tools so you can either download this program or take a photo for future reference. We don't just make things up- there are actual rules for this stuff.



DISCLAIMER

Although one, or more, of your speakers are a member of various NFPA committees, The Health Guidelines Revisions Committee, and/or other super important committees that impact the rules regulations and guidelines of how we design and manage healthcare facilities - the views and opinions expressed in this presentation are purely those of the speakers and shall not be considered the official position of the NFPA or any of its technical committees, the FGI Guidelines, or any official entity and shall not be considered to be, nor relied upon, as a formal interpretation.

Oh, also- we borrowed slides (with permission) from some of our industry friends and will do our best to clearly identify those.



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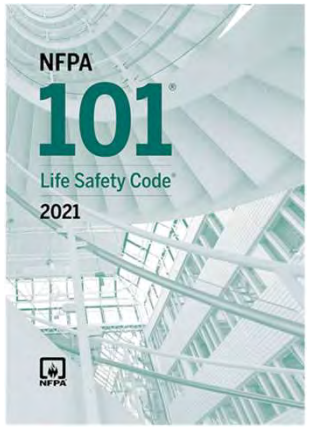
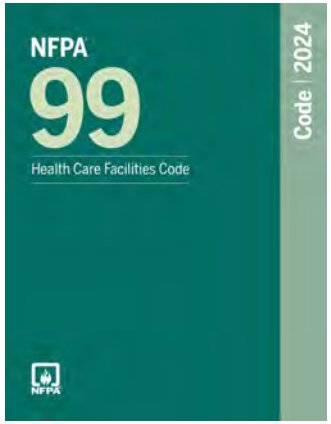
CODES & STANDARDS

CODES & STANDARDS | HIERARCHY REFERENCED DOCUMENTS*

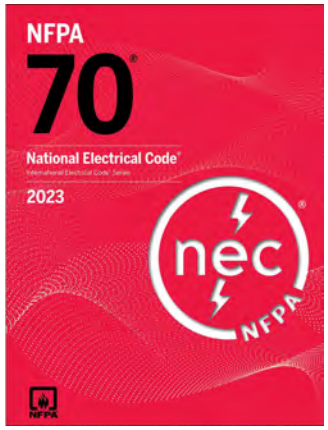
When to do it



How to do it



How to install it



What to do - Standard

UL 891

*Note editions will vary and State and Local Codes in addition to Other Code Families and Standards also apply

CODES & STANDARDS | RELEVANT REFERENCES

NFPA 99: *Health Care Facilities Code, 2024 ed*

1.1 Scope.

1.1.1 The scope of this document is to establish minimum criteria as follows in 1.1.2 through 1.1.14.

1.1.4 Electrical Systems

1.1.4.2 (1) Specific requirements for wiring and installation of electrical systems and components thereof are covered in NFPA 70.

NFPA 70: *National Electrical Code, 2023 ed*

90.2 Use and Application.

90.2(A) Practical Safeguarding.

The purpose of this *Code* is the practical safeguarding of persons and property from hazards arising from the use of electricity. This *Code* is not intended as a design specification or an instruction manual for untrained persons.

90.2(B) Adequacy.

This *Code* contains provisions that are considered necessary for safety. Compliance therewith and proper maintenance result in an installation that is essentially free from hazard but not necessarily efficient, convenient, or adequate for good service or future expansion of electrical use.

NOTE: NFPA 99, 2012 ED: Articles 1.1 and 1.1.4.2 (1) have similar requirements

CODES & STANDARDS | RELEVANT REFERENCES

FGI *Guidelines for Design and Construction of Hospitals, 2022 ed*

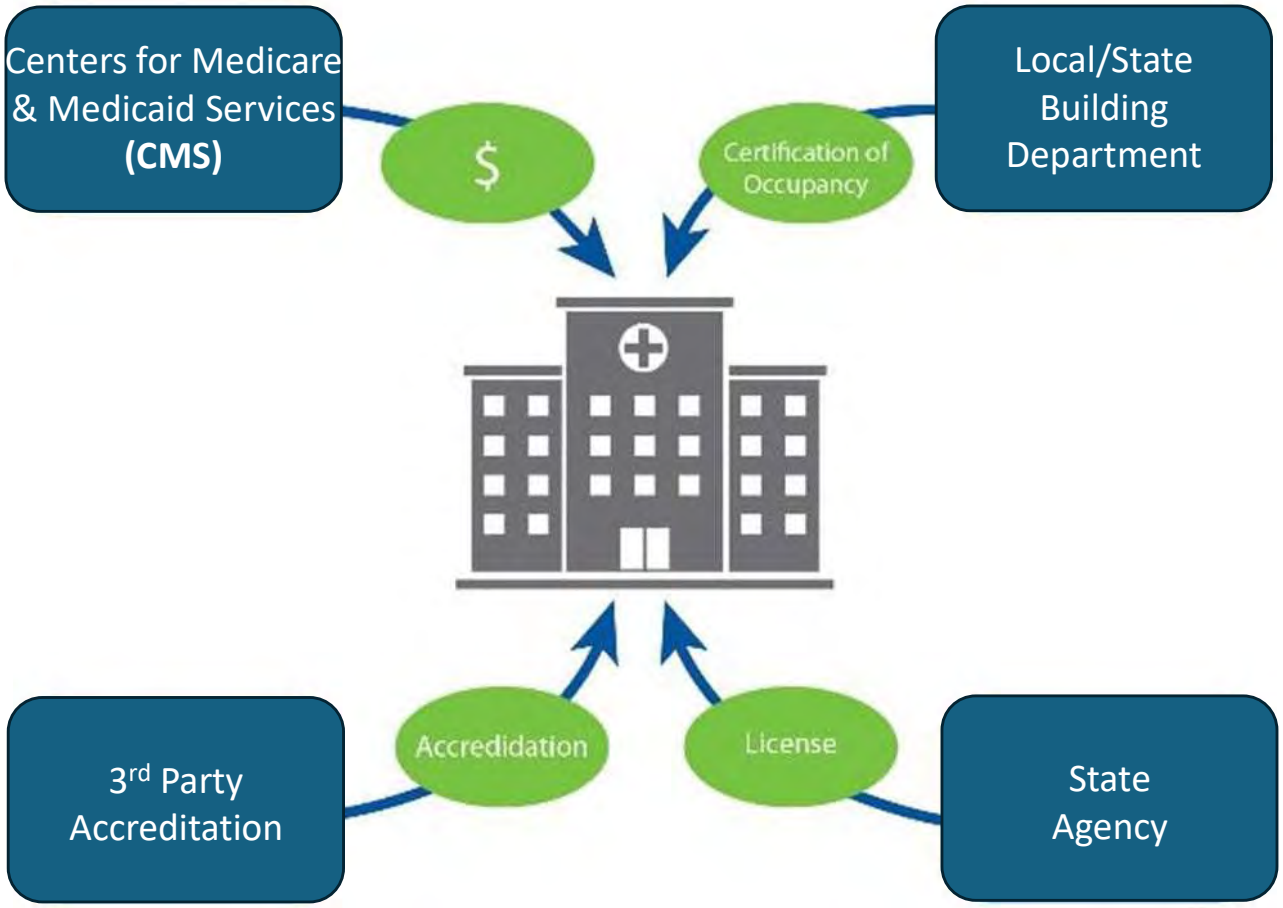
Disclaimers

FGI endeavors to develop performance-oriented and evidence-based minimum requirements as guidance for design of U.S. health care facilities without prescribing design solutions. Those using this document should rely on their own independent judgment or, as appropriate, seek the advice of a competent professional in determining the exercise of reasonable care in any given circumstance.

CODES & STANDARDS | FGI - 2026 BIG CHANGES AHEAD

- Minimum requirements
- Adoptable
- No Appendix
- Print + digital

- Guidance
- Graphics
- Tools
- Digital only



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CODES & STANDARDS | CHALLENGE OF MINIMUM REQUIREMENTS

- National codes and standards have been developed to coordinate with federal and state regulations for reimbursement and occupancy compliance.

- With very few exceptions, these codes and standards are written as minimum requirements to establish a threshold that must be achieved for minimal compliance.

- Minimum standards may become the benchmark for design and are often less than optimal—and sometimes inadequate—for the clinical end user and the patient population.


WARNING
NOT ALL STATES AND JURISDICTIONS ADOPT, ENFORCE, OR REQUIRE THE SAME CODES, STANDARDS AND GUIDELINES. USE CODE REFERENCES AS A GUIDE.
PLUS - CODES ARE ALWAYS CHANGING*

DESIGN PROCESS BASICS


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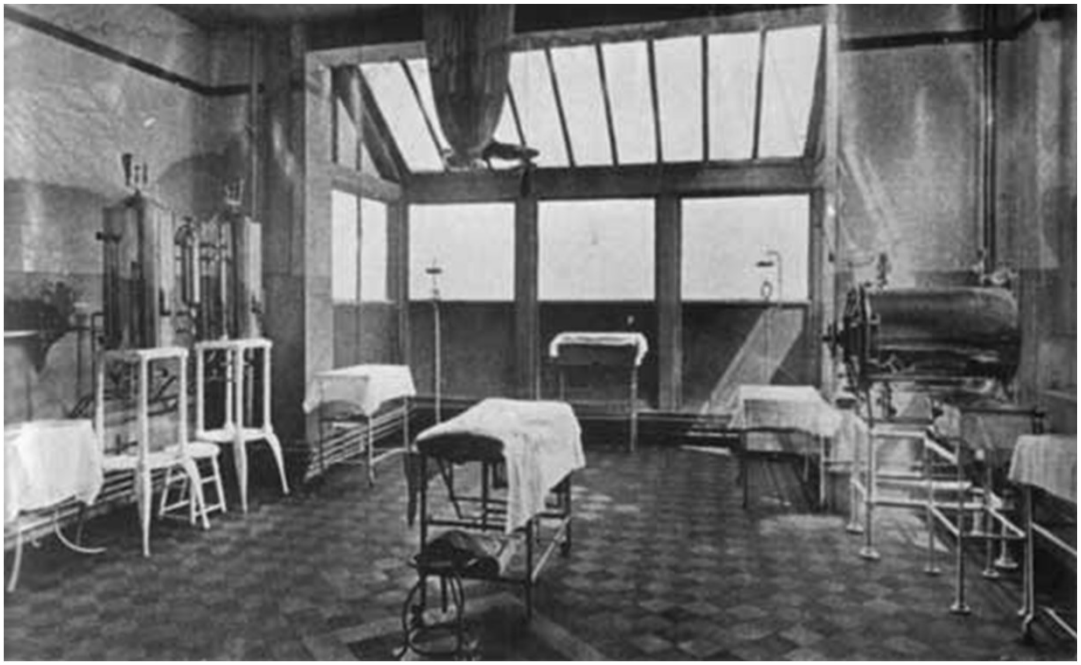
DESIGN PROCESS BASICS | WHERE TO START FOR REAL

- Understand codes and guidelines (minimum criteria)
- Understand function of the room
- Establish criteria
- Work with Users of space AND the Health Care facility's Governing body



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DESIGN PROCESS BASICS | BIG QUESTIONS

- What procedures will be done in the room?
- Is it a Hybrid OR with fixed imaging?
- Will it be a dedicated room?
- Do you have equipment to relocate?
- How much flexibility is desired?
- What engineering systems are required?
- What infrastructure is required or existing?
- What types of technology will be utilized
- What is your budget?

(We know… it's tacky to talk about money)

DESIGN PROCESS BASICS | EMERGENCY MANAGEMENT

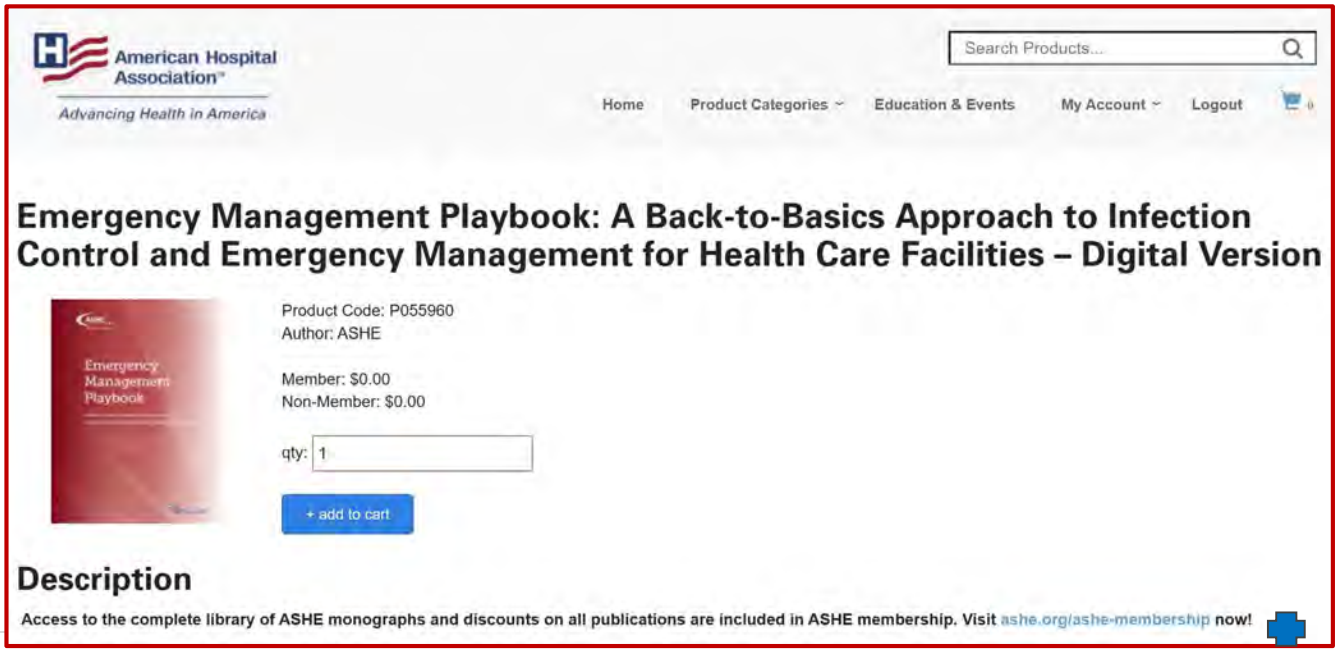
NFPA 99, 2024 ED

NOTE: NFPA 99, 2012 ED Article 12.5.3.3.6.5 has similar requirements. 2012 added wastewater and IT.

12.5.3.3.6.5 * Essential Utilities and Systems.

The facility shall plan for continuity of operations during the loss or interruption of the following utilities and systems during an emergency, as applicable:

(1) Electricity
(2) Potable water
(3) Nonpotable water
(4) Wastewater
(5) HVAC
(6) Fire protection
(7) Fuel for building operations
(8) Fuel for essential transportation
(9) Medical gas and vacuum
(10) Information technology



WET PROCEDURE LOCATION

WET PROCEDURE LOCATION | CODE REQUIREMENTS

NFPA 99, 2024 ED

NOTE: NFPA 99, 2012 ED: Article 6.3.2.2.8 has similar requirements

6.3.2.3 Wet Procedure Locations.

6.3.2.3.1 *

Wet procedure locations shall be provided with special protection against electric shock.

6.3.2.3.2

This special protection shall be provided as follows:

(1) Power distribution system that inherently limits the possible ground-fault current due to a first fault to a low value, without interrupting the power supply
(2) Power distribution system in which the power supply is interrupted if the ground-fault current does, in fact, exceed the trip value of a Class A GFCI

6.3.2.3.3

Patient beds, toilets, bidets, and wash basins shall not be required to be considered wet procedure locations.

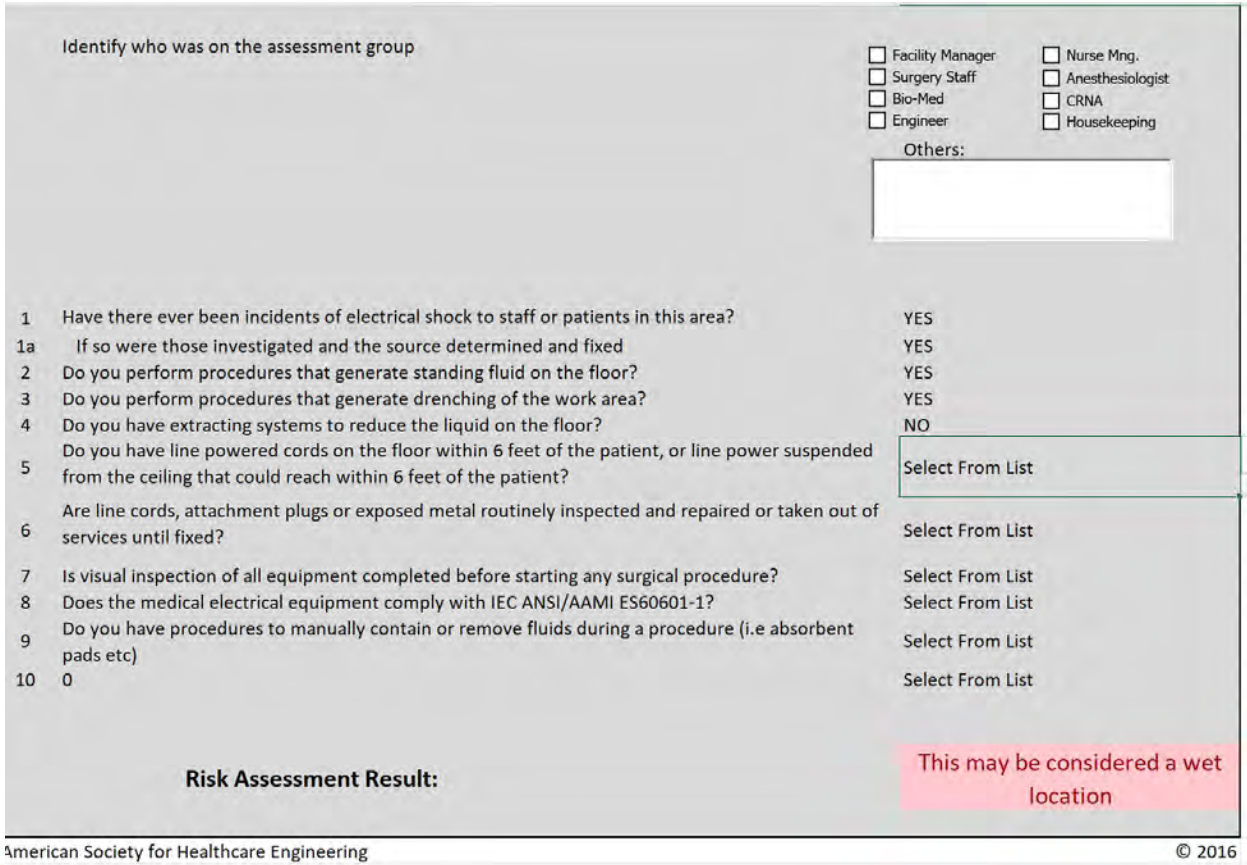
6.3.2.3.4 *

Operating rooms shall be considered to be a wet procedure location, unless a risk assessment conducted by the health care governing body determines otherwise.

6.3.2.3.5

If the risk assessment conducted by the health care facility's governing body, as defined in Chapter 3, determines that the operating room is not a wet procedure location, then the special protection of 6.3.2.3 shall not be required.

WET PROCEDURE LOCATION | ASHE RISK ASSESSMENT TOOL



	Identify who was on the assessment group	☐ Facility Manager ☐ Nurse Mng. ☐ Surgery Staff ☐ Anesthesiologist ☐ Bio-Med ☐ CRNA ☐ Engineer ☐ Housekeeping Others:
1	Have there ever been incidents of electrical shock to staff or patients in this area?	YES
1a	If so were those investigated and the source determined and fixed	YES
2	Do you perform procedures that generate standing fluid on the floor?	YES
3	Do you perform procedures that generate drenching of the work area?	YES
4	Do you have extracting systems to reduce the liquid on the floor?	NO
5	Do you have line powered cords on the floor within 6 feet of the patient, or line power suspended from the ceiling that could reach within 6 feet of the patient?	Select From List
6	Are line cords, attachment plugs or exposed metal routinely inspected and repaired or taken out of services until fixed?	Select From List
7	Is visual inspection of all equipment completed before starting any surgical procedure?	Select From List
8	Does the medical electrical equipment comply with IEC ANSI/AAMI ES60601-1?	Select From List
9	Do you have procedures to manually contain or remove fluids during a procedure (i.e absorbent pads etc)	Select From List
10	0	Select From List
	Risk Assessment Result:	This may be considered a wet location

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WET PROCEDURE LOCATION | CODE REQUIREMENTS

NFPA 70, 2023 ED

NOTE: NFPA 70, 2011 ED Article 517.20 has similar requirements

517.20 Wet Procedure Locations.

517.20(A) Receptacles and Fixed Equipment.

Wet procedure locations shall be provided with special protection against electric shock. [**99:**6.3.2.3.1]

This special protection shall be provided by one of the following:

(1) Isolated power systems that remain in operation in the event of a single line-to-ground fault condition that inherently limits the possible ground-fault current due to a first fault to a low value, without interrupting the power supply
Informational Note No. 1: Isolated power systems can eliminate the danger of electric shock to patients who might be more susceptible to leakage current and unable to move in their beds.

(2) Power distribution system in which the power supply is interrupted if the ground-fault current does, in fact, exceed the trip value of a Class A GFCI
Informational Note No. 2: See Annex E of ANSI/UL 943-2018, *Ground-Fault Circuit-Interrupters*, and110.3(B) for the manufacturers' installation instructions of listed ground-fault circuit interrupters for information on the supply connection of life-support equipment to circuits providing ground-fault circuit-interrupter (GFCI) protection of personnel at outlets.

[**99:**6.3.2.3.2]

Exception: Branch circuits supplying only listed, fixed, therapeutic, and diagnostic equipment shall be permitted to be supplied from a grounded service, single- or 3-phase system if the following conditions are met:

(1) Wiring for grounded and isolated circuits does not occupy the same raceway.
(2) All conductive surfaces of the equipment are connected to an insulated copper equipment grounding conductor.

SPECIAL PROTECTION

SPECIAL PROTECTION | CODE REQUIREMENTS

NFPA 99, 2024 ED

NOTE: NFPA 99, 2012 ED Article 6.3.2.2.8.6 has similar requirements

6.3.2.3.7

The use of an isolated power system (IPS) shall be permitted as a protective means capable of limiting ground-fault current without power interruption if the IPS complies with 6.3.2.9.

6.3.2.3.8 *

Operating rooms defined as wet procedure locations shall be protected by either isolated power or ground-fault circuit interrupters.

6.3.2.3.9

Where GFCI protection is used in an operating room, one of the following shall apply:

(1) Each receptacle shall be an individual GFCI device.
(2) Each receptacle shall be individually protected by a single GFCI device.

NOTE: Article 6.3.2.3.9 is not in NFPA 99, 2012 ED

OR NOT AND

SPECIAL PROTECTION | ISOLATED POWER VS GFCI

- **Isolated Power Panels:**
  - Isolate OR equipment from main power supply to prevent faults.
  - Continuously monitor faults without cutting power.
  - Reduce electrical noise for stable equipment operation.
  - **Safety**: Lower risk of electrical shock during surgery.
- **Ground Fault Circuit Interrupters (GFCIs):**
  - Detect current imbalances and cut power to prevent shock.
- **Limitations in OR**:
  - Can disrupt equipment if power is cut during a fault.
- **Key Differences:**
  - **IPPs**: Continuous monitoring, no power disruption.
  - **GFCIs**: Power cuts can interfere with surgery.

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SPECIAL PROTECTION | ISOLATED POWER

- **Isolation Transformer:** Electrically separates the OR from the main grid, preventing direct connection to the building's ground.
- **No Direct Grounding:** Reduces shock risk and interference in sensitive environments.
- **Ground-Fault Detection and Alarms:** Detects leakage currents and faults, alerting staff immediately.
- **Continuous System Monitoring:** Ensures system integrity, preventing issues before they affect patient or staff.
- **Surge and Interference Protection:** Filters electrical noise and surges, ensuring safe equipment operation.

SPECIAL PROTECTION | WHY NOT USE BOTH STRATEGIES TOGETHER

- **Contradictory Functions:**
  - Isolated power ensures stable, uninterrupted power for sensitive equipment.
  - GFCI detects ground faults and interrupts power to prevent electrical shock.
- **Operational Conflict:**
  - Isolated systems tolerate minor leakage currents, while GFCIs may trip at harmless levels, causing unnecessary power interruptions.
- **Risk of False Alarms:**
  - GFCIs might trip due to normal leakage in isolated systems, disrupting critical equipment.
- **Safety Standards:**
  - Medical electrical systems follow standards recommending either isolated power or GFCI, not both.
- **Using both can lead to unreliable equipment operation in critical environments.**

DESIGN BASICS

DESIGN BASICS | FGI - ARCHITECTURAL BASICS

HOSPITAL

(1) [Standard] operating room

(a) Area. Each operating room shall have a minimum clear floor area of 400 square feet (37.20 square meters).

(b) Clearances. The following minimum clearances shall be provided around the operating table, gurney, or procedural chair:

(i) 8 feet 6 inches (2.59 meters) on each side

(ii) 6 feet (1.83 meters) at the head. This dimension shall result in an anesthesia work zone with a clear floor area of 6 feet x 8 feet (1.83 meters x 2.4 meters).

(iii) 7 feet (2.13 meters) at the foot

(c) An operating room used for cesarean and other delivery procedures shall meet the requirements in Section 2.2-2.10.11.1 (Cesarean delivery room).

*(2) Operating room for image-guided surgery using portable imaging equipment or surgical procedures that require additional personnel and/or large equipment

(a) An operating room of this type shall:

(i) Be sized to accommodate the personnel and equipment planned to be in the room during procedures.

(ii) Have a minimum clear floor area of 600 square feet (55.74 square meters) with a minimum clear dimension of 20 feet (6.10 meters).

(b) Where renovation work is undertaken and it is not possible to meet the above minimum standards, these rooms shall have a minimum clear floor area of 500 square feet (46.50 square meters) with a minimum clear dimension of 20 feet (6.10 meters).

OUTPATIENT

*(1) Area

A2.1-3.2.4.2 (1) To allow for an operating room to be used for different procedures in the future, a health care organization may choose to build a larger operating room than needed for the services they are currently providing.

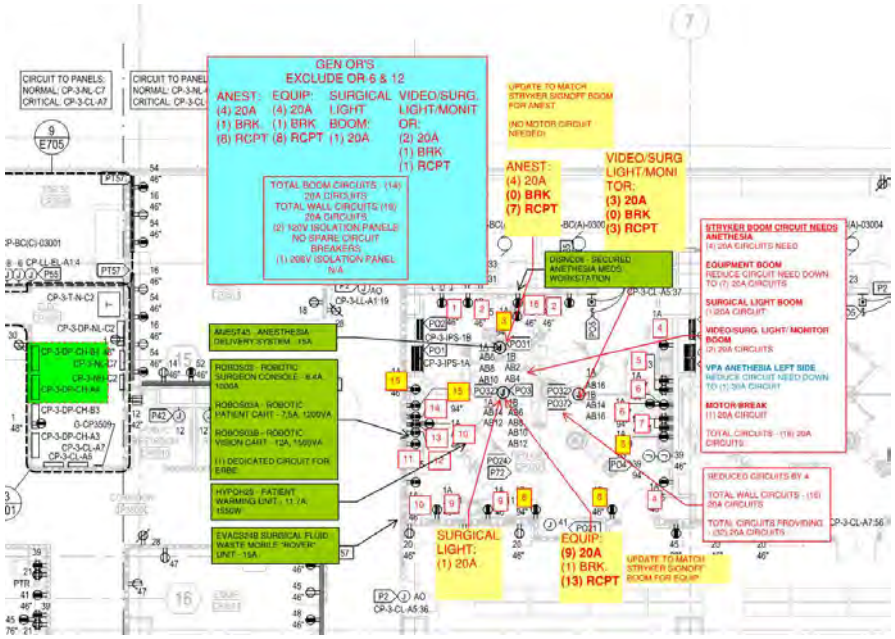
(a) An operating room shall have a minimum clear floor area of 255 square feet (23.69 square meters).

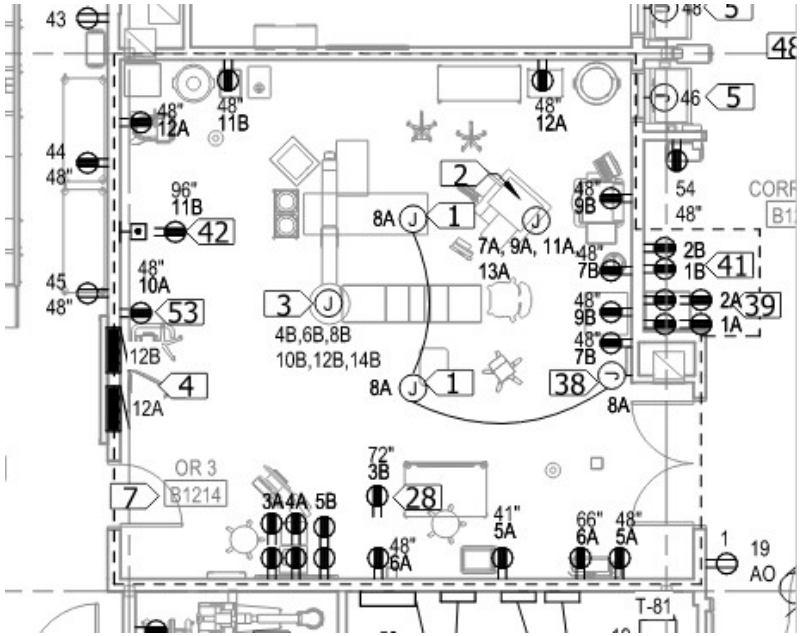
(b) An operating room where anesthetics will be administered using an anesthesia machine and supply cart shall have a minimum clear floor area of 270 square feet (25.08 square meters).

*(c) An operating room where surgery that may require additional staff and equipment will be performed shall have a minimum clear floor area of 400 square feet (37.16 square meters).

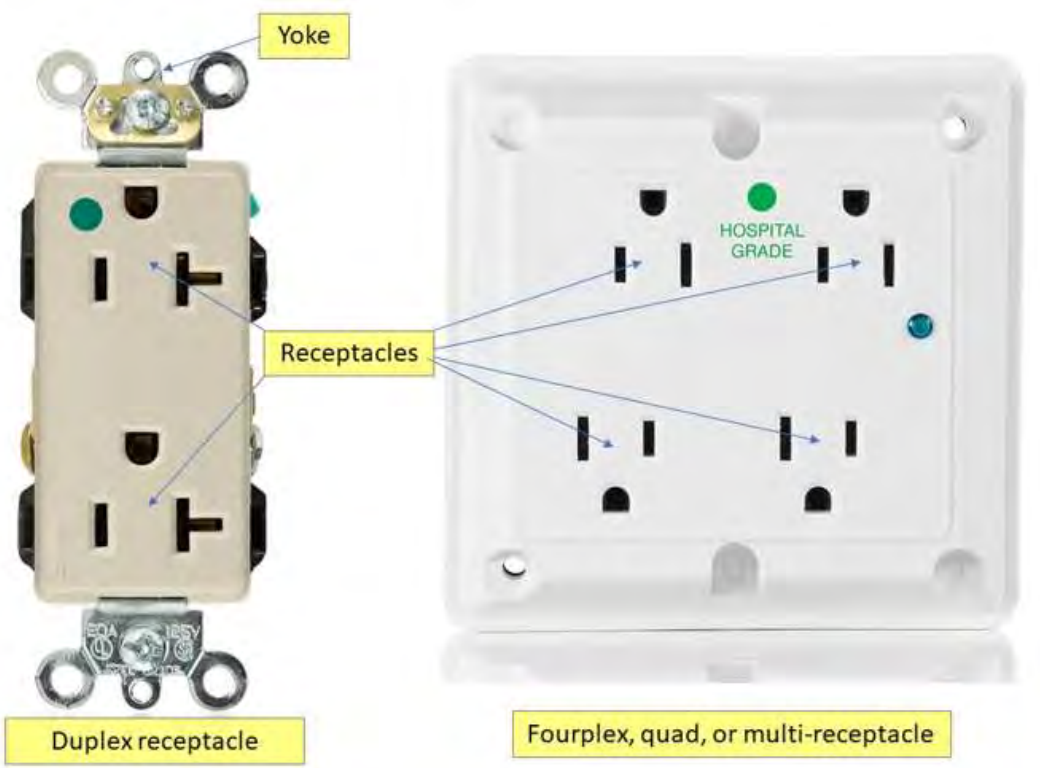
A2.1-3.2.4.2 (1)(c) Space requirements for operating rooms for procedures that require additional personnel/large equipment. Operating rooms for surgical procedures that require additional personnel and/or large equipment should be sized to accommodate the personnel and equipment planned to be in the room during procedures, including any additional personnel and equipment that will be needed for emergency rescue. These operating rooms may need to have a clear floor area of 600 to 1,000 square feet (55.74 to 92.9 square meters).

DESIGN BASICS | HOSPITAL AND OUTPATIENT





DESIGN BASICS | DEFINITION OF A RECEPTACLE



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DESIGN BASICS | MINIMUM NUMBER OF RECEPTACLES

NFPA 99, 2024 ED

NOTE: NFPA 99, 2012 ED Article 6.3.2.2.6.2 (C) Only Indicates 36 receptacles without the quantity per source.

6.3.2.2.2 Minimum Number of Receptacles.

The number of receptacles shall be determined by the intended use of the spaces in accordance with 6.3.2.2.2(A) through 6.3.2.2.2(E).

(C) Receptacles in Operating Rooms.

Each operating room shall be provided with a minimum of 36 125-volt, 15- or 20-ampere receptacles, at least 12 of which shall be connected to either the normal branch circuit or a critical branch circuit supplied by a different transfer switch other than the receptacles at the same location. They shall be permitted to be of the single, duplex, or quadruplex type, or any combination of the three. Other receptacles (e.g., portable x-ray receptacles) serving special-purpose, cord-and-plug-connected equipment shall be permitted to be of the locking or non-locking-type.

NFPA 70, 2023 ED

517.19(C) Operating Room Receptacles.

NOTE: Not in NFPA 70, 2011 ED

517.19(C)(1) Minimum Number and Supply.

Each operating room shall be provided with a minimum of 36 receptacles divided between at least two branch circuits. At least 12 receptacles, but no more than 24, shall be connected to either of the following:

(1) The normal system branch circuit required in 517.19(A)
(2) A critical branch circuit supplied by a different transfer switch than the other receptacles at the same location

517.19(C)(2) Receptacle Requirements.

The receptacles shall be permitted to be of the locking or nonlocking type and of the single, duplex, or quadruplex types or any combination of the three.

All nonlocking-type receptacles shall be listed hospital grade and so identified. The grounding terminal of each receptacle shall be connected to the reference grounding point by means of an insulated copper equipment grounding conductor.

DESIGN BASICS | MINIMUM NUMBER OF RECEPTACLES

2022 Guidelines for Design and Construction of Hospitals

2.2-3.4.3.5 Building system components

(1) Electrical receptacles. See Table 2.1-1 (Electrical Receptacles for Patient Care Areas in Hospitals) for requirements.

(2) Medical gas and vacuum systems. See Table 2.1-3 (Oxygen, Vacuum, Medical Air, WAGD, and Instrument Air Systems) for requirements.

(3) Communications system

(a) All operating rooms shall be equipped with an emergency communication system that incorporates push activation of an emergency call switch.

(b) Each operating room shall have a system for emergency communication with the surgery department control station.

(c) For nurse call requirements, see Table 2.1-2 (Locations for Nurse Call Devices in Hospitals).

Table 2.1-1: Electrical Receptacles for Patient Care Areas in Hospitals

DIAGNOSTIC AND TREATMENT AREAS

2.2-3.4.3	Operating room	36[5]	16 convenient to table placement
2.2-3.5.2.1 (3)	Class 3 imaging room		2 on each wall

NOTE: Consistent with NFPA 70 and NFPA 99

DESIGN BASICS | CMS AND POWER STRIPS

Life Safety Code surveyors assess the use of power strips in healthcare facilities. However, the following guidance is provided as reference for healthcare surveyors as they survey physical environment along with other CoP requirements. Any observed power strip deficiencies should be conveyed to the LSC surveyors for citation.

If line-operated medical equipment is used in a patient care room/area, inside the patient care vicinity:

- UL power strips would have to be a permanent component of a rack-, table-, pedestal-, or cart-mounted & tested medical equipment assembly
- Power strips providing power to medical equipment in a patient care room/area must be UL 1363A or UL 60601-1
- Power strips cannot be used for non-medical equipment

If line-operated medical equipment is used in a patient care room/area, outside the patient care vicinity:

- UL power strips could be used for medical & non-medical equipment with precautions as described in the memo
- Power strips providing power to medical equipment in a patient care room/area must be UL 1363A or UL 60601-1
- Power strips providing power to non-medical equipment in a patient care room/area must be UL 1363

If line-operated medical equipment is not used in a patient care room/area, inside and outside the patient care vicinity:

- UL power strips could be used with precautions

Power strips providing power to non-medical equipment in a patient care room/area must be UL 1363. In non-patient care areas/rooms, other UL strips could be used with the general precautions.

State Operations Manual
Appendix A - Survey Protocol, Regulations and Interpretive Guidelines for Hospitals

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(Rev. 220; Issued:04-19-24)

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DESIGN BASICS | CMS AND POWER STRIPS

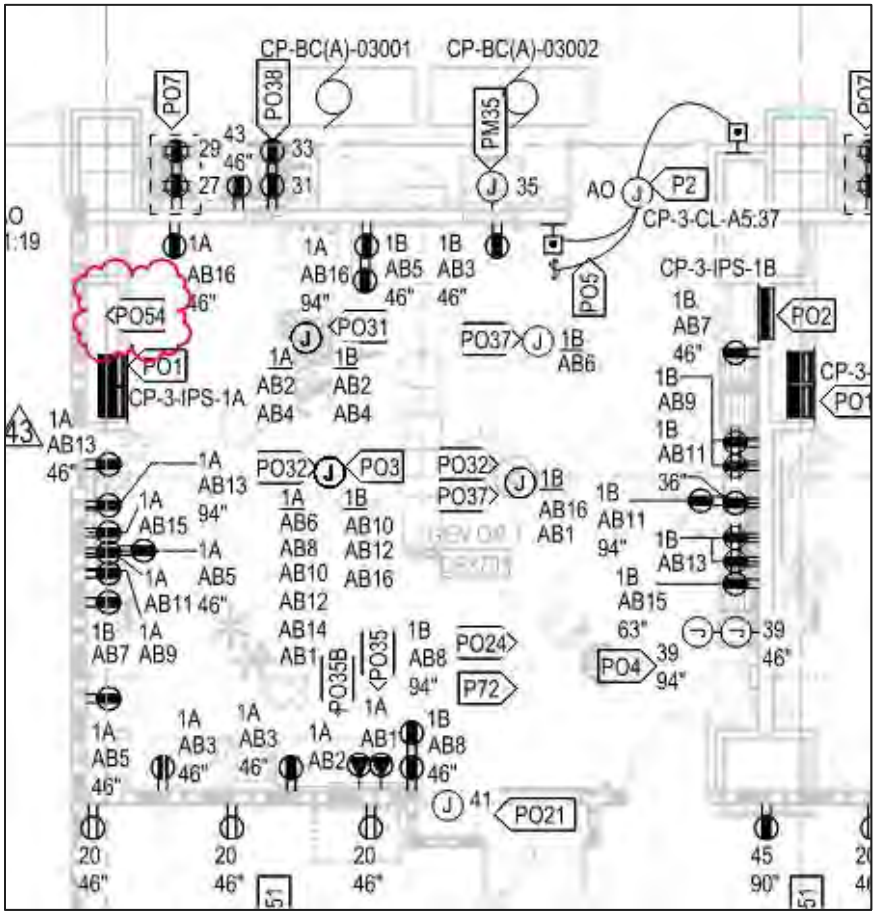
The Joint Commission
Requirements for Improvement

Program: Ambulatory

Standard	EP	SAFER™ Placement	EP Text	Observation	CfC	CfC Score
EC.02.05.01	23	Low Limited	Power strips in a patient care vicinity are only used for components of movable electrical equipment assemblies used for patient care. These power strips meet UL 1363A or UL 60601-1. Power strips used outside of a patient care vicinity, but within the patient care room, meet UL 1363. In non–patient care rooms, power strips meet other UL standards. (For full text, refer to NFPA 99-2012: 10.2.3.6; 10.2.4; NFPA 70-2011: 400-8; 590.3(D); Tentative Interim Amendment [TIA] 12-5) Note 1: The mounting of power strips to medical equipment assemblies or the reconfiguration of equipment powered by power strips in a medical equipment assembly must be performed by personnel who are qualified to make certain that this is done in accordance with NFPA 99-2012: 10.2.3.6. Note 2: Per NFPA 99-2012: 3.3.138, patient care room is defined as any room of a health care facility wherein patients are intended to be examined or treated. Per NFPA 99-2012: 3.3.139, patient care vicinity is defined as a space, within a location intended for the examination and treatment of patients, extending 1.8 meters (6 feet) beyond the normal location of the bed, chair, table, treadmill, or other device that supports the patient during examination and treatment and extending vertically to 2.3 meters (7 feet, 6 inches) above the floor. Note 3: In new facilities, the number of receptacles shall be in accordance with NFPA 99-2012: 6.3.2.2.6.2. If patient bed locations in existing health care facilities undergo renovation or a change in occupancy, the number of receptacles must be increased to meet the requirements of NFPA 99-2012: 6.3.2.2.6.2 to eliminate the need for power strips.	1). Observed in Building Tour at [redacted] site. A pole-mounted power strip (RPT) in O.R. #1 was not permanently mounted to the pole. This finding was observed by the Facility Director.	§416.44	Standard

INSTALLATION

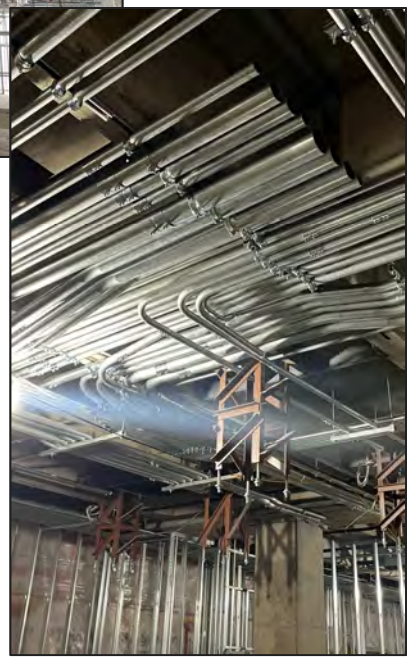
INSTALLATION | OPERATING ROOM IN 2D



INSTALLATION | OPERATING ROOM IN 3D

REGION 6 ASHE

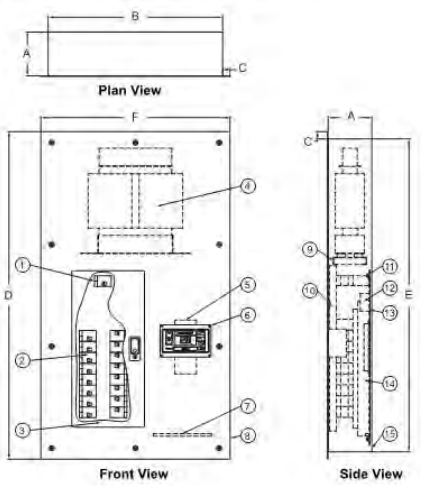
INSTALLATION | CONSTRUCTION



INSTALLATION | ISOLATED POWER PANELS

- **Voltage Options**
  - Primary: **480V**, 277V, 208V, 120V
  - Secondary: **120V**, 208V, 240V
- **Depth**
  - Can be as deep as 14”
  - Walls need to be coordinated with architect and general contractor
- **Location**
  - Placement dictates circuit lengths to receptacles
- Side-by-side panels can be problematic

Figure 1: Backbox Mounting—SIP Panel



Item	Description	Item	Description
1	Main circuit breaker, 2P	9	Transformer shelf
2	Branch circuit breakers, 2P	10	Breaker deadfront
3	Stainless steel door with lock	11	Backplate mounting studs
4	Isolation transformer, 1 Phase	12	Distribution block, 2P
5	LIM connector plate	13	Backplate
6	Line isolation monitor, 1 Phase	14	Load center
7	Ground bus	15	Backbox, galvanized steel
8	Stainless steel front trim		

Dimension	3, 5 kVA	7.5, 10 kVA	15 kVA	25 kVA
A	6 in. (152 mm)	8 in. (203 mm)	12 in. (305 mm)	14 in. (356 mm)
B	24 in. (610 mm)		30 in. (762 mm)	
C	Flush: 1 in. (25 mm) Surface: 0 in. (0 mm)			
D	Flush: 45 in. (1143 mm) Surface: 43 in. (1092 mm)		Flush: 53 in. (1346 mm) Surface: 51 in. (1295 mm)	
E	43 in. (1092 mm)		51 in. (1295 mm)	
F	Flush: 26 in. (660 mm) Surface: 24 in. (610 mm)		Flush: 32 in. (813 mm) Surface: 30 in. (762 mm)	

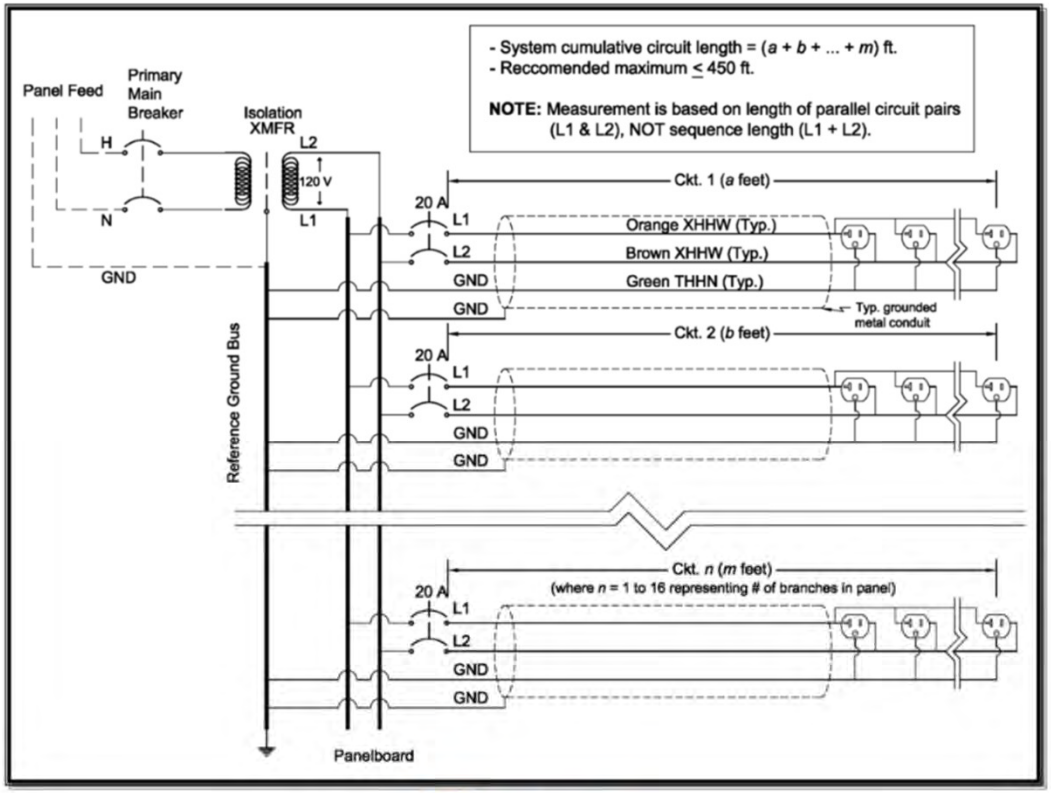
INSTALLATION | RECEPTACLES

REGION 6 ASHE

INSTALLATION | MEANS AND METHODS

- **Conduit**
  - ¾” or larger
  - No more than two circuit per conduit
  - Must take most direct possible route
- **Wire**
  - Must use XHHW rather than THHN due to better insulative properties
  - Special color coding per NEC:
    - Conductor 1: Orange w/ Stripe (connects to “neutral” terminal of receptacle)
    - Conductor 2: Brown w/ Stripe (connects to “hot” terminal of receptacle)
    - Ground: Green w/ Stripe
- **No wire pulling compound** – Results in increased leakage current
- **No splices!**

INSTALLATION | ISOLATED POWER CIRCUIT LENGTHS



PG LifeLink
Innovation In Power Safety

- 450-500 ft maximum
- Based on actual wire lengths
- One-way, not round trip
- Early planning is critical

ISOLATED POWER SYSTEMS
Field Wiring Guidelines

BENDER
The Power in Electrical Safety

Circuit Length

NEC defines the minimum acceptance criteria for impedance to ground for the isolated power system to be 200kΩ; thus, on 120V system, the maximum allowable system hazard current can be calculated as follows:

- $I\,total = \frac{V}{Z} = \frac{120\,V}{200\,k\Omega} = 600\,uA$

The manufacture's permissible leakage (Im) for the Isolated Power System itself (excluding field wiring) according to UL-1047 (table 30.1 & 30.2) can be shown as follows:

- $I\,m = I\,interior + I\,transformer \rightarrow 50\,uA + 25\,uA = 75\,uA$

Leakage current of XLPE wire (Iw) is 1 µA/ft in metallic conduit, as per IEEE 602-2007. It is recommended to use a conservative value of 1.1 µA/ft. allowing for manufacture variations. Therefore, the recommended Isolated Conductor length ($Wmax$) can be calculated as follows:

- $Wmax = (Itotal - Im) \div Iw \rightarrow (600uA - 75uA) \div 1.1uA \cong 480ft$

NOTE: The above calculations should be used as a "rule of thumb" during system design and installation, however an installation with >480ft of conductor length will NOT always fail to meet the NEC impedance requirement.

TESTING AND COMMISSIONING

TESTING AND COMMISSIONING | NFPA 99 REQUIREMENTS

- **Receptacles**
  - The continuity of the grounding circuit in each electrical receptacle shall be verified.
  - The correct polarity of the hot and neutral connections in each electrical receptacle shall be confirmed.
  - The retention force of the grounding blade of each electrical receptacle (except locking-type receptacles) shall be not less than 115 grams (4 ounces).
  - For new construction, the impedance measurement shall be made between the reference point and the grounding contact of 10% of all receptacles within the patient care vicinity.
- **Voltage for Equipotential Grounding**
  - For exposed conductive surfaces in patient care vicinity, voltage limit from surface to reference point shall be 20mV.
- **Line Isolation Monitors**
  - Verify operation by simulating external faults – See manufacturer commissioning

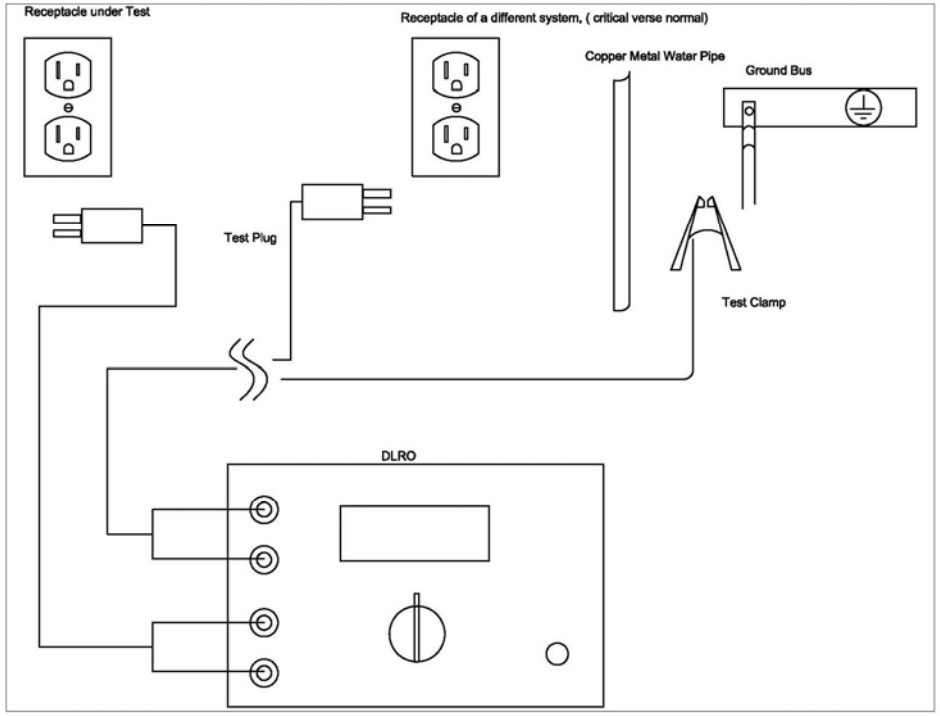
RECEPTACLE TESTING IN PATIENT CARE AREAS

PROJECT:		CLIENT NAME:	Essentia	DATE:	3/24/2025
PROJECT NUMBER:	C13414	PROJECT ADDRESS:			

ArchKey SOLUTIONS

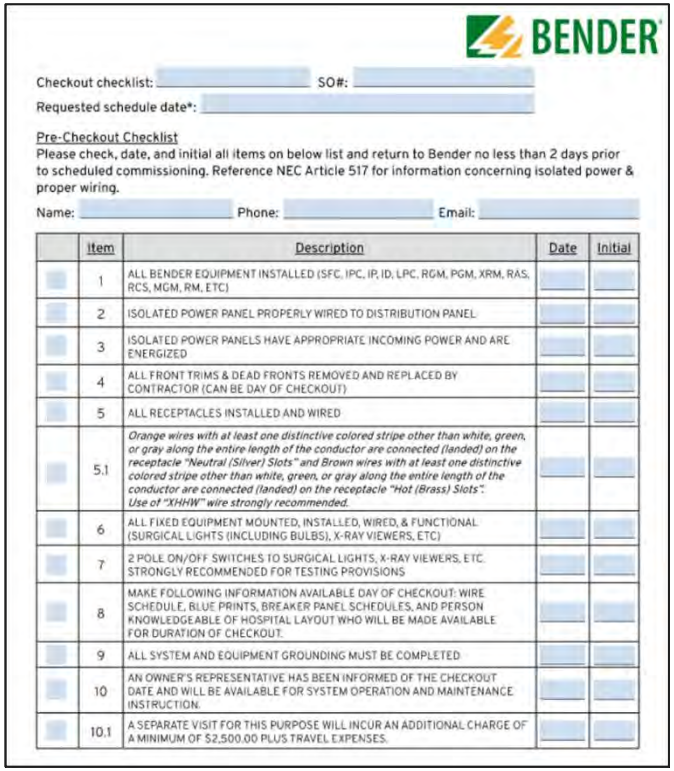
ROOM/AREA	RECEPTACLE LOCATION	RECEPTACLE SERVED FROM	TEST GROUND SOURCE	VOLTAGE BETWEEN TERMINALS	NORMAL POWER	EMERG POWER	IMPEDANCE MEASUREMENT (0.1 Ohms MAX.) See Note 3	VERIFICATION OF PHYSICAL INTEGRITY (VISUAL INSPECTION)	CONFIRMATION OF CORRECT POLARITY (HOT AND NEUTRAL)	RETENTION FORCE OF GROUND BLADE (115g (4oz) MINIMUM)
2S300	Counter Right 1	IR321	Panel Ref GND Bus	120.3	○	◉	8.61	☑	☑	☑
2S300	Counter Right 2	IR321	Panel Ref GND Bus	120.3	○	◉	8.9	☑	☑	☑
2S300	Counter Center 1	IR321	Panel Ref GND Bus	120	○	◉	7.02	☑	☑	☑
2S300	Counter Center 2	IR321	Panel Ref GND Bus	120.1	○	○	6.53	☑	☑	☑
2S300	South 1	IR321	Panel Ref GND Bus	120.3	○	◉	6.86	☑	☑	☑
2S300	South 2	IR321	Panel Ref GND Bus	120.1	○	◉	7.38	☑	☑	☑
2S300	East 1	IR321	Panel Ref GND Bus	120.3	○	◉	6.74	☑	☑	☑
2S300	North 1	IR321	Panel Ref GND Bus	120.3	○	◉	6.42	☑	☑	☑
2S300	North 2	IR321	Panel Ref GND Bus	120.3	○	◉	7.35	☑	☑	☑
2S300	West 1	IR321	Panel Ref GND Bus	120.3	○	◉	7.91	☑	☑	☑
2S300	West 2	IR321	Panel Ref GND Bus	120.4	○	◉	5.9	☑	☑	☑
2S300	West upper	IR321	Panel Ref GND Bus	120.1	○	◉	6.88	☑	☑	☑
2S300	Steris Arm 1	IR321	Panel Ref GND Bus	120.4	○	◉	10.05	☑	☑	☑
2S300	Steris Arm 2	IR321	Panel Ref GND Bus	120.4	○	◉	9.07	☑	☑	☑
2S300	Steris Arm 3	IR321	Panel Ref GND Bus	120.4	○	◉	9.61	☑	☑	☑
2S300	Steris Arm 4	IR321	Panel Ref GND Bus	120.4	○	◉	11.01	☑	☑	☑
2S300	Steris Arm 5	IR321	Panel Ref GND Bus	120.4	○	◉	9.58	☑	☑	☑
2S300	Steris Arm 6	IR321	Panel Ref GND Bus	120.4	○	◉	9.74	☑	☑	☑
2S300	Electrical 2S300a	IR321	Panel Ref GND Bus	120.4	○	◉	6.31	☑	☑	☑
					○	○		☐	☐	☐
					○	○		☐	☐	☐
					○	○		☐	☐	☐
					○	○		☐	☐	☐
					○	○		☐	☐	☐

TESTING AND COMMISSIONING | TEST EQUIPMENT



REGION 6 ASHE

TESTING AND COMMISSIONING | MANUFACTURER



BENDER

Checkout checklist: _____ SO#: _____

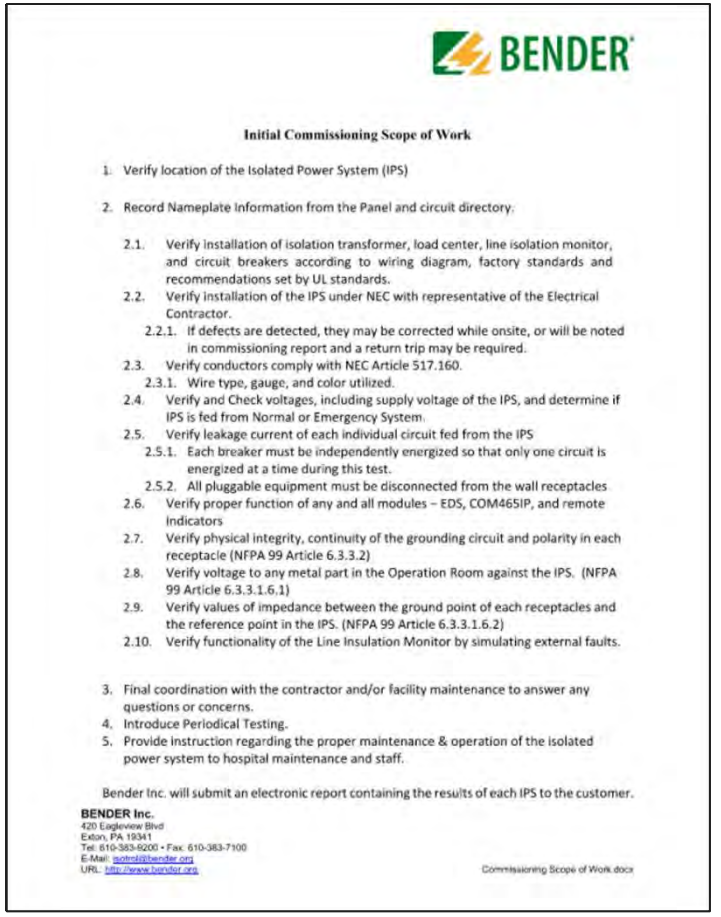
Requested schedule date*: _____

Pre-Checkout Checklist

Please check, date, and initial all items on below list and return to Bender no less than 2 days prior to scheduled commissioning. Reference NEC Article 517 for information concerning isolated power & proper wiring.

Name: _____ Phone: _____ Email: _____

	Item	Description	Date	Initial
	1	ALL BENDER EQUIPMENT INSTALLED (SFC, IPC, IP, ID, LPC, RGM, PGM, XRM, RAS, RCS, MGM, RM, ETC)		
	2	ISOLATED POWER PANEL PROPERLY WIRED TO DISTRIBUTION PANEL		
	3	ISOLATED POWER PANELS HAVE APPROPRIATE INCOMING POWER AND ARE ENERGIZED		
	4	ALL FRONT TRIMS & DEAD FRONTS REMOVED AND REPLACED BY CONTRACTOR (CAN BE DAY OF CHECKOUT)		
	5	ALL RECEPTACLES INSTALLED AND WIRED		
	5.1	*Orange wires with at least one distinctive colored stripe other than white, green, or gray along the entire length of the conductor are connected (landed) on the receptacle "Neutral (Silver) Slots" and Brown wires with at least one distinctive colored stripe other than white, green, or gray along the entire length of the conductor are connected (landed) on the receptacle "Hot (Brass) Slots". Use of "XHHW" wire strongly recommended.*		
	6	ALL FIXED EQUIPMENT MOUNTED, INSTALLED, WIRED, & FUNCTIONAL (SURGICAL LIGHTS (INCLUDING BULBS), X-RAY VIEWERS, ETC)		
	7	2 POLE ON/OFF SWITCHES TO SURGICAL LIGHTS, X-RAY VIEWERS, ETC. STRONGLY RECOMMENDED FOR TESTING PROVISIONS		
	8	MAKE FOLLOWING INFORMATION AVAILABLE DAY OF CHECKOUT: WIRE SCHEDULE, BLUE PRINTS, BREAKER PANEL SCHEDULES, AND PERSON KNOWLEDGEABLE OF HOSPITAL LAYOUT WHO WILL BE MADE AVAILABLE FOR DURATION OF CHECKOUT.		
	9	ALL SYSTEM AND EQUIPMENT GROUNDING MUST BE COMPLETED		
	10	AN OWNER'S REPRESENTATIVE HAS BEEN INFORMED OF THE CHECKOUT DATE AND WILL BE AVAILABLE FOR SYSTEM OPERATION AND MAINTENANCE INSTRUCTION.		
	10.1	A SEPARATE VISIT FOR THIS PURPOSE WILL INCUR AN ADDITIONAL CHARGE OF A MINIMUM OF $2,500.00 PLUS TRAVEL EXPENSES.		



BENDER

Initial Commissioning Scope of Work

1. Verify location of the Isolated Power System (IPS)
2. Record Nameplate Information from the Panel and circuit directory.
   - 2.1. Verify installation of isolation transformer, load center, line isolation monitor, and circuit breakers according to wiring diagram, factory standards and recommendations set by UL standards.
   - 2.2. Verify installation of the IPS under NEC with representative of the Electrical Contractor.
     - 2.2.1. If defects are detected, they may be corrected while onsite, or will be noted in commissioning report and a return trip may be required.
   - 2.3. Verify conductors comply with NEC Article 517.160.
     - 2.3.1. Wire type, gauge, and color utilized.
   - 2.4. Verify and Check voltages, including supply voltage of the IPS, and determine if IPS is fed from Normal or Emergency System.
   - 2.5. Verify leakage current of each individual circuit fed from the IPS
     - 2.5.1. Each breaker must be independently energized so that only one circuit is energized at a time during this test.
     - 2.5.2. All pluggable equipment must be disconnected from the wall receptacles
   - 2.6. Verify proper function of any and all modules – EDS, COM465IP, and remote Indicators
   - 2.7. Verify physical integrity, continuity of the grounding circuit and polarity in each receptacle (NFPA 99 Article 6.3.3.2)
   - 2.8. Verify voltage to any metal part in the Operation Room against the IPS. (NFPA 99 Article 6.3.3.1.6.1)
   - 2.9. Verify values of impedance between the ground point of each receptacles and the reference point in the IPS. (NFPA 99 Article 6.3.3.1.6.2)
   - 2.10. Verify functionality of the Line Insulation Monitor by simulating external faults.
3. Final coordination with the contractor and/or facility maintenance to answer any questions or concerns.
4. Introduce Periodical Testing.
5. Provide instruction regarding the proper maintenance & operation of the isolated power system to hospital maintenance and staff.

Bender Inc. will submit an electronic report containing the results of each IPS to the customer.

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IN CONCLUSION

IN CONCLUSION

- FGI, NFPA 70, NFPA 99 (CMS and currently adopted editions) are as close to alignment as codes get.
- Wet procedure locations and requirement for special provisions need to be directed by a risk assessment by the Facility's Governing Body.
- You CANNOT use BOTH isolated power panels AND GFCI in the same operating room.
- Larger Operating Rooms require more strategies for installation.
- Testing, commissioning, and maintenance is not only a code requirements, but a manufacturer's requirement and just a darn good idea.

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SPLICE GIRLS POD CAST

Check Out Our Website!