Technical News Bulletin
The National Institutes of Health | Division of Technical Resources | Office of Research Facilities
Issue 158
March
2026

Electrical Design Requirements for Radiopharmacies and Imaging Suites

Introduction

Radiopharmacies and advanced imaging suites are often designed using baseline healthcare electrical criteria without fully recognizing their heightened sensitivity to waveform integrity and dynamic load behavior. For the purposes of this bulletin, advanced imaging suites include modalities such as magnetic resonance imaging (MRI), computed tomography (CT), positron emission tomography (PET), single-photon emission computed tomography (SPECT), and other diagnostic imaging systems whose performance may be influenced by electrical waveform disturbances. Imaging systems, cyclotrons, dose calibration equipment, and automated dispensing platforms support patient care and research protocols where subtle electrical instability can affect clinical accuracy without causing equipment shutdown. Electrical design in these environments must therefore address not only compliance with the NIH *Design Requirements Manual* Chapter 6, Chapter 7 and Chapter 10, but also performance assurance aligned with applicable industry standards including National Fire Protection Association (NFPA) Standard 70, NFPA 99, Institute of Electrical and Electronics Engineers (IEEE) Standard 519, and IEEE 1159.

The electrical service architecture that supports imaging environments typically includes normal and essential power distribution, segregation of disturbance-producing loads (e.g., large variable frequency drives or pulsed imaging equipment), harmonic management, compatibility with uninterruptible power supply systems (where required), and grounding strategies that support stable equipment operation. Some imaging equipment manufacturers recommend that interconnected imaging components be supplied from a common upstream electrical source to minimize potential differences between system components and reduce the likelihood of electrical noise affecting system performance. These elements should be considered during design to maintain reliable electrical conditions for imaging equipment and related processes.

Power Quality as a Design Driver

Electrical systems serving imaging and radiopharmacy areas must be engineered with voltage stability and harmonic control as defined performance parameters. Total harmonic distortion at the point of common coupling should comply with the limits established in IEEE 519 for harmonic control in electric power systems. Within the facility distribution system, evaluate power quality performance to prevent excessive waveform distortion that could affect sensitive imaging equipment. Internal distribution performance is typically governed by equipment manufacturer requirements and an engineering evaluation informed by IEEE 519 principles rather than by direct IEEE 519 compliance limits within the facility distribution system. Assess voltage sag magnitude and duration relative to the documented ride-through capability of imaging equipment. Stable electrical conditions help reduce the likelihood of imaging artifacts, minimize stress on sensitive electronic components, support consistent patient throughput, and maintain reliable system performance during clinical operation.

Pulsed and Nonlinear Load Coordination

Imaging equipment, gradient systems, radio-frequency (RF) amplifiers, and isotope production systems introduce high crest factor and rapidly varying electrical loads that interact with upstream system impedance and may influence voltage stability within the facility distribution system. Evaluate system stiffness at imaging distribution panels through short circuit and voltage dip analysis consistent with accepted engineering practice. Where appropriate, provide dedicated transformers or segregated feeders to isolate nonlinear or harmonic-producing loads from general building distribution. When nonlinear load contribution is significant, consider harmonic studies to verify acceptable power quality conditions and to prevent resonance or excessive neutral loading.

Grounding and Shield Integration

Grounding and bonding in shielded imaging rooms require coordination with RF shielding systems to maintain equipotential conditions and minimize noise injection. MRI systems are particularly sensitive to voltage differences relative to ground that may introduce noise or artifacts in scan data, while other modalities such as CT systems are generally more tolerant of minor grounding variations. Bonding of penetrations and waveguides should ensure continuity with the building grounding electrode system in accordance with

Technical News Bulletin
The National Institutes of Health | Division of Technical Resources | Office of Research Facilities
Issue 158
March
2026

the NIH *Design Requirements Manual* and applicable provisions of National Electrical Code Article 250 and Article 517. Proper bonding of shielding systems with the facility grounding electrode system helps maintain equipotential conditions while preserving shielding effectiveness. Grounding design should incorporate appropriate bonding practices and may include isolated grounding circuits, where justified, for sensitive equipment as well as high-frequency signal reference grounding that supports stable operation of imaging electronics. Proper grounding of imaging equipment minimizes harmonics and noise; technical grounding configurations should avoid ground loops that may introduce instrumentation instability or imaging artifacts. Utilize shielded cables to ensure that electromagnetic interference (EMI) and high-frequency currents are safely diverted.

Uninterruptible Power Supply (UPS) and Emergency Power Compatibility

UPS systems serving imaging and radiopharmacy equipment should be evaluated for compatibility with nonlinear and high crest factor loads. Inverter crest factor rating, harmonic handling capability, and generator transfer performance should be verified against equipment requirements where continuity of operation is required. Essential electrical system distribution within healthcare facilities is governed by NFPA 99, which establishes requirements for branch circuits, transfer equipment, and electrical system reliability within patient care environments. Emergency power supply systems, including generator sets and associated transfer equipment, are governed by NFPA 110. UPS systems may be applied to support sensitive imaging equipment, provide ride-through capability during transfer between normal and alternate power sources, or allow orderly shutdown of equipment where appropriate. The primary risks associated with the UPS system include its inability to manage high-power inrush during system startup, frequent shutdowns resulting from inadequate maintenance cycles, and reliability issues tied to improper grounding.

Permanent Power Quality Monitoring

Permanent power quality monitoring may assist facilities in identifying electrical disturbances affecting sensitive equipment. Monitoring at the point of common coupling and at distribution panels serving imaging equipment can track harmonic distortion, voltage unbalance, neutral currents, and disturbance events consistent with IEEE 1159 characterization practices. Baseline power quality measurements obtained during commissioning provide reference data for future comparison and may help identify gradual degradation in electrical conditions.

Conclusion

Radiopharmacies and imaging suites require electrical systems engineered for waveform integrity, dynamic load coordination, precise grounding, and continuous verification. Compliance with the NIH DRM and governing codes remains mandatory; however, performance assurance in these environments depends on thoughtful evaluation of power quality, upstream electrical distribution configuration, grounding practices, and monitoring strategies. Electrical design decisions must therefore be assessed not only for regulatory sufficiency, but for their impact on imaging performance, equipment reliability, and research mission continuity at the National Institutes of Health.

References

1. IEEE Standards Association. IEEE Std 519 2022. IEEE Standard for Harmonic Control in Electric Power Systems. Institute of Electrical and Electronics Engineers.
2. IEEE Standards Association. IEEE Std 1159 2019. IEEE Recommended Practice for Monitoring Electric Power Quality. Institute of Electrical and Electronics Engineers.
3. National Fire Protection Association. NFPA 70 National Electrical Code.
4. National Fire Protection Association. NFPA 99 Health Care Facilities Code.
5. National Fire Protection Association. NFPA 110 Standard for Emergency and Standby Power Systems.