Digital imaging and the future

Planning a flexible infrastructure

By Tom Leonidas Jr.

The use of digital imaging technologies in patient care is constantly evolving as new digital equipment and modalities offer increased image resolution for diagnostics, treatment and intervention. As technologies shift, healthcare facilities must make major capital investments to upgrade equipment, as well as provide new infrastructure to support it. The impacts typically seen are in power distribution and data infrastructure support, which typically need to be up-sized. There is no 'silver bullet' in the design of infrastructure that can totally accommodate any and all equipment changes, as each manufacturer is unique. However, it is possible to address some of the major shifts in digital equipment and build in capacities to easily accommodate those changes.

GUDRON/DREAMSTIME

Upgrades necessary to accommodate new equipment impact smaller hospitals the most, as they have access to fewer capital dollars. Industry studies predict that in 2009, hospitals with 200 beds or less will invest heavily in change out of imaging equipment, and adopting technologies such as picture archiving communication systems, 64-slice CT, 3T MRI and digital mammography. As hospitals spend money now to accommodate technological changes, it is a perfect opportunity to plan infrastructure to support future power and data upgrades as well. It is important to address both new equipment and infrastructure upgrades together as a package, as they are interdependent upon each other to support digital imaging.

The power strategy

Determining how to power digital imaging equipment is perhaps the most important issue to address. Serving the equipment power needs both at the switchgear and distribution system as well as to the actual equipment room must be addressed, in addition to the impact on the IT closets that power the servers, network switches and storage servers that support digital imaging. Determining exactly what equipment is and is not on emergency power, is crucial.

Ideally, digital imaging equipment should be served by a dedicated power distribution branch off of the main electrical service. This helps isolate digital imaging equipment from other equipment in the hospital in the case of power disturbances. With a closer connection to the main electrical service, any power interruptions are lessened because those disturbances represent a relatively smaller percentage impact compared to being further upstream. The National Electrical Code gives requirements for maximum allowable voltage drop to the load. However, radiology equipment is extremely susceptible to power fluctuations and care should be taken to improve upon the manufacturer's stated limitations. If a source close to the main service is not available, another option is to install point-of-service power conditioning equipment at digital imaging equipment.

Digital radiology equipment tends to use more power than non-digital equipment, so it is wise to 'think big' when considering feeders. A rule of thumb is to upgrade one feeder and conduit size from the one in place for existing equipment. This will cost incrementally more in a new construction or renovation project, but it is less pricey than the cost of a future upgrade. Such foresight is a common sense approach and cheap insurance.

Additional power should be considered for the image archiving systems that operate in tandem with digital imaging systems. Picture archiving communication systems — or PACs — store digital radiology images for future retrieval and require storage servers as their foundations.

Larger hospital networks may have a centralized data center in which the PACs reside, but those that do not will need PACs storage on-site. PACs storage is best concentrated in a single server room on-site, but nevertheless, the increased power requirements for network attached storage, storage area networks and other PACs-related equipment should be taken into account when planning feeder sizes. The design

BRANCHING OUT

Connecting to the correct emergency branch

The National Electrical Code NEC 517 for healthcare facilities stipulates three code-required branches: life safety, critical, and equipment. Digital radiology equipment should be connected to an equipment branch transfer switch.

In multiple and paralleled scenario generator installations, the automatic transfer switch serving the radiology equipment can be assigned a load-shed priority that fits within the overall needs of the hospital as to what loads get shut down first, if the available generator capacity is exceeded due to a system failure. Closed transition type transfer switches should also be considered if the owner is averse to having loads momentarily drop during normal generator system testing. Closed transition transfer switches 'make before break' and more smoothly transition the load to the emergency source without dropping the load momentarily during transfer.

Deciding which pieces of radiology equipment to put on emergency power requires some prudence. While the best of all worlds is to have everything on emergency power, it is unfeasible to load up generators for the sake of convenience. Rather, the best approach is to understand the caregiving needs which are a hospital's 'essential services,' in a prolonged power outage and determine what modalities of radiology equipment are essential to caregiving needs. Once that is determined, it is easier to decide which loads should go on the emergency power system. Other non-essential but 'nice to have' radiology equipment loads can also be put on a manual transfer switch so that if spare capacity is available on an actual demand load basis, individual pieces of equipment can be manually served by emergency power. Using the manual transfer switch method is a less costly way to provide additional options of adding other equipment to the emergency on a case by case basis.

THE BANDWIDTH ISSUE

The growing use of digital imaging has increased the demand for bandwidth in hospitals. The present and future direction of digital imaging is to provide images with more detail at a higher resolution. Many healthcare facilities also demand real-time digital imaging at the desktop. This additional technology translates into higher data transfers as well as the need for increased data storage for robust picture archiving communication systems.

Many hospitals do not have the full IT infrastructure to support the growth in bandwidth for digital imaging. There are two planning aspects to consider in the IT infrastructure that supports digital imaging — the vertical backbone structure and the desktop cabling structure.

Strategically, one must decide how and where digital radiology images will be pushed throughout the hospital. Typically, there are targeted areas to which radiology images would get pushed, but in today's world of electronic health records, radiology images are likely to get pushed to workstations in many areas of the hospital as well as to remote locations such as physicians' offices. Today, a gigabit network is considered the minimum standard, but network technology will increase to allow higher distributed bandwidth.

Another issue that comes up in planning is the role of wireless and the ability to view digital images over a wireless 802.11 network. At present, this is unfeasible as an 802.11x network would not handle the bandwidth requirements. Any other applications such as electronic healthcare records would get bogged down to a halt. Wireless technologies continue to make strides, and in the future, these issues could be surmounted.

of power to these rooms should be included when planning server design, room HVAC requirements and, most importantly, future growth projections. Spare capacity in feeders to these rooms should be built in during the initial design of the space, as it is less expensive to incrementally up-size feeders initially than it is to add or modify existing feeders at a later date.

With increasing mandates to provide healthcare records electronically, digital imaging becomes even more vital. Digital imaging becomes an integral part of the electronic record and will likely need to be available during a power outage. Best practice is for the hospital to strategically select digital imaging equipment that is needed during a power outage and connect it to emergency power using dedicated automatic transfer switches. This will allow the equipment to be load-shed if necessary during a generator overload, and to be managed better during weekly generator tests which will momentarily drop the load.

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An integrated strategy

As we've seen, digital imaging — along with the challenges associated with electronic health record integration — has significant infrastructure impacts on new and existing hospitals. It is common for a hospital to focus solely on the equipment itself; justifiably so, as new equipment is increasing the quality of care. However, the infrastructure costs to properly prepare for the future in terms of adequate power and IT infrastructure can be equal to or even greater than the cost of the equipment itself. A focused electrical and IT strategy should be developed by engaging the appropriate stakeholders: radiology staff, IT staff, engineering, design staff and administration. Questions that should be raised include:

- What areas inside and outside of the hospital will need access — real time and archival — to digital imaging?
- What type of network, server and storage architecture supports digital imaging and OACs, and where is this equipment located?
- What digital imaging equipment is essential during a power outage, and from what emergency power branch and load-shed priority will digital imaging be sourced?
- What should be included in the IT closets that support the network architecture required for digital imaging?
- What size cabling should be used?

Once a strategy had been defined, it is then time to assess the facility's needs versus what is actually in place. Necessary upgrades for existing facilities and start-up costs for new construction must be assessed so the true cost of the digital imaging equipment does not come as a surprise.

There's no question the impact of digital radiology equipment on a facility's infrastructure is wide ranging and costly. But with careful planning, digital technology will become a revenue generator that should outweigh the costs of its implementation. ■

Tom Leonidas, Jr., P.E., is a healthcare practice leader and vice president at Sparling, a Seattle-based electrical and technology consulting firm that specializes in healthcare planning and design. He can be reached at tleonidas@sparling.com.