

Top 10 Considerations for MRI Suite Planning



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EXPERIENCES AND OUTCOMES***

 **ETS·LINDGREN**[®]
An ESCO Technologies Company

WHERE DO I START IN PLANNING MY MRI PROJECT?

What is most important to you? The type of image or how fast can you obtain an image? The features and benefits and how much these may impact your budget? These are typical initial thoughts when planning a MRI suite. Your facility may have a preference on the type or brand of MRI equipment to purchase. If so, this is a great place to start your planning as almost all equipment vendors have manuals with typical drawings and professional staff that can consult on the siting of their equipment. If you are undecided or have decided on your equipment selection, most planners will engage an architectural firm and varying consultants, including ETS-Lindgren, to help develop the space. There are many areas to consider in this planning stage that when carefully addressed will result in a high quality MRI suite that exceeds your staff and patient expectations. Following is a summary of the top considerations to evaluate RF shielding when planning your MRI suite to maximize patient and staff flow as well as efficiencies and longevity.

1. Understand the Importance of the RF Shielded Enclosure.

The RF shielded enclosure that houses your MRI magnet is not a building component but a piece of support equipment, just like a chiller or MRI equipment itself. The RF shielding actually resides in the wall so its importance is often overlooked. If the RF shield does not work – the MRI does not work. Pay careful attention to the type of shield selected and avoid shielding that is installed directly onto your parent building, such as the layered or wall paper type. The performance with this type of shielding typically downgrades significantly over a standard lifetime of usage, thus compromising the performance of your MRI magnet over time.

ETS-Lindgren manufactures and installs the most extensive shielding methods available in the industry. After decades of experience, two shielding methods are recommended as ideal for healthcare applications.

2. Appreciate the Importance of the RF Shielded Door.

The most important feature of the RF shielded enclosure noted above is the RF shielded door. A door is expected to attenuate radio frequency for proper use of the magnet, at the same time it should be considered to be acoustically matched to its host environment. The door should be easy to open for everyday use, it should be aesthetically pleasing for patients and staff, and it should endure the use of the space. Selecting a door with machined construction can provide longer-term performance. A door with a high acoustic (STC) rating to minimize the sound of the magnet for staff and patients outside the shielded enclosure is a popular option. Vendors should provide cycle test data for reference. If you are interested in card readers, key pads, interlock options, auto retracting or automatic opening/closing operators, these can complement your safety and security protocols for the MRI space. You may want a flat threshold to ease going in and out regularly. For example, a flush threshold with the MRI suite is desired for patients transferred into the suite on a gurney or seated in a wheelchair. Many companies downplay the door and long-term overall performance so pay attention to what you are selecting.

ETS-Lindgren manufactures the only acoustically tested MRI door with a STC 44 rating (with lower ratings available). Known as the Model EVO Series, these contemporary designed doors are provided with manual or pneumatic opening features with an easy to clean flat or low profile threshold.





3. Don't Overlook the Environment for the MRI Equipment, Including Acoustic Implications.

With the introduction of more powerful gradient coils on today's MRI scanners, MRI equipment is producing increasingly higher noise levels. During a typical scan sequence, many MRI systems will produce average sound pressure levels (SPL) as high as 100 to 110 dBA, with peak levels of 120 dB — which compares to busy street traffic noise levels. These high scanner noise levels can interfere with patient comfort, patient to technician communication and adjacent work spaces. As a result, staff efficiency is adversely affected. This causes numerous considerations to be taken into account when planning for acoustic shielding. Addressing each of the following considerations can help to determine the proper acoustic shielding solutions as well as the extent of the shielding needed to ensure that no issues are left unattended. ETS-Lindgren can help with the analysis of the following considerations.

- a. **Building structure (existing or future).** Determine what, if any, acoustic enhancement exists. Determine the level of transmission loss in the walls, floors and ceilings. If plans are for a new structure, evaluate the building materials and construction plans, and contact ETS-Lindgren for the full acoustic manual, to plan for acoustically favorable construction.
- b. **Type of MRI equipment.** Decibel levels will vary according to the type of scanner and its gradient coil components. These levels can be obtained from the magnet manufacturer. Inquire with the magnet OEM if they offer a “quiet” package to improve the noise level from the magnet.
- c. **Transmission path of noise, if known.** Determine whether the noise is airborne or structure-borne, or both. Each requires a different method of sound absorption.
- d. **Surrounding rooms.** Determine what the adjacent rooms are (or will be) used for, and how often they will be occupied. If the noise is (or will be) a concern to the occupants of the surrounding rooms, determine the noise level that is transmitted to adjacent rooms.
- e. **Frequency of MRI equipment use/frequency of peak noise.** Determine how often, or how many hours per day, the equipment will be operated. Evaluate how often this will involve peak noise levels.
- f. **Upgrades or modifications.** Upgrades or modifications of the MRI equipment, the MRI suite, surrounding rooms, or the purpose of surrounding rooms all need to be considered when planning for acoustic shielding.

4. Remember the Impact of Electromagnetic Interference (EMI) and Vibration Effects on MRI Equipment.

MRI equipment have specification limits for both EMI and vibration in order to ensure effective siting. These levels can be obtained from the magnet manufacturer and may be measured with recommended solutions from the equipment provider. There are several factors that are considered in both new construction and/or renovation projects. While these planning concerns will mostly be addressed with plans and specifications, typically physical on-site measurements are required to determine siting feasibility and/or remedy recommendations.

MRI siting will address construction methods, structure, electrical conduit placement, electrical rooms, elevator locations, parking or traffic and subways as examples. The physical vibration test measures a frequency domain response from 0-200 Hz along with reporting on sources of the vibration. On site EMI testing looks at static (Gauss), DC fluctuations, AC fields and Magnetic field bandwidth DC up to 30 MHz in the XYZ axis for determining the source of disturbances, if any.

ETS-Lindgren performs both EMI and vibration studies as part of our technical solutions team and offers proven solutions to remedy these concerns.

5. For Large Projects, Utilize Building Information Modeling (BIM) to Effectively Manage the Budget and Schedule.

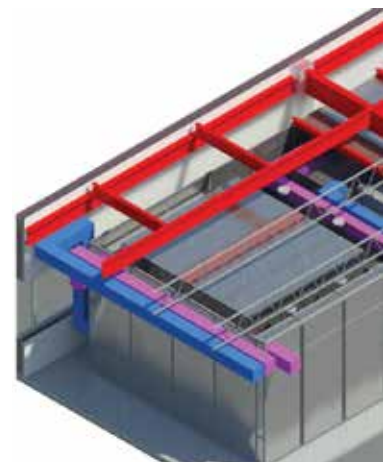
Building Information Modeling (BIM) is recommended and sometimes required for projects involving the design and installation of a facility. BIM is a process that enables better insight and predictability of the physical and functional characteristics of a facility – before it is built – and records this for future use.

It includes the generation of 3D digital representations of the structure's architecture as well as the mechanical, electrical and plumbing (MEP) so users can see how the RF shielded enclosure will interface with their parent building. BIM becomes a resource of shared knowledge, facilitating collaboration between users, architects and general contractors.

The MRI suite and magnet are a considerable investment; by using BIM, users can have a better understanding of the entire project and how to address any potential problems upfront, during the design phase. This record of detail of the building and shield system can also be a major benefit for this investment. It provides the detail for facilities management to have the information to provide maintenance, to review product or check locations in case of failures, or provide valuable information for future space renovation or upgrades.

A series of walk-through videos can be created to give a realistic simulation of patient and personnel movement through the designed space. This can be very beneficial in determining optimal patient access routes, for example.

Projects using BIM result in lower expense and risk through reduced construction delays, rework, and/or onsite problems. ETS-Lindgren has an in-house Autodesk Certified Professional design team that is proficient in BIM to minimize the inherent risk in your construction project and secure valuable information for the future. Rely on the expertise of our engineers and consultants using BIM to effectively manage the budget and schedule.





6. Understand the Importance of and Available Options to Address Patient Comfort.

Healthcare facilities in the past were designed to be functional, with little thought to the patients' emotional comfort or needs. This is now changing throughout the healthcare industry. Research shows that by incorporating nature and addressing the patients' emotional comfort and needs, better results can be achieved for the patient, staff and facility.

An MRI scan often requires an extended period of time in a confined area. To enhance patient comfort, design considerations should be considered from the moment the patient enters the imaging suite. For example, RF shielded doors should be architectural in design to provide an easy-open, lever-style handle. A low friction design makes it easy to open for MR technicians while the concealed seal design is aesthetically pleasing to patients.

Since colors stimulate our nervous system, they are able to influence mood and provoke certain reactions. As a consequence, the use of color can be used to make an environment or examination seem less intimidating or anxiety-provoking. Less anxiety and a more positive mood may translate into a better physical state, fostering the body's own healing process. A variety of window treatment options, including "faux" windows with scenic wall paper images, expand a patients "view" beyond the confined MRI environment. ETS-Lindgren's Med-Vizion™ GDP (Graphic Display Panel) system is easily installed and creates a calming environment for patients and staff. It illuminates photographic scenes with a natural uniform light, creating a realistic illusion of the outdoors.

General lighting will be required. Soft white LED lights and those in down light installations are most soothing to patients. ETS-Lindgren's Med-Vizion ZXR down light is the standard solution in lighting technology specifically designed and tested for MRI suite applications. Offering dimmable equivalent 150 watt down lights, this high performance, light emitting diode has no UV, IR or RF emissions and features engineered heat displacement in a low profile can for long lasting LED lights. A flat panel option is available with ETS-Lindgren's Med-Vizion LFP line; this is an excellent lighting solution for MRI rooms with limited ceiling space and other similar applications. These lights consist of an LED lighting guide-plate with built-in LEDs, and provide an efficient, no glare, uniform luminance across the lighting panel. With an external LED driver power supply, the LFP2x2 or LFP2x4 Series meets all MRI vendor siting requirements for lighting.

7. Be Aware of and Plan to Meet Safety Requirements for Patients and Staff.

Does conforming to the guidelines published by the Centers for Medicare and Medicaid Services (CMS), American College of Radiology (ACR) and/or the Facility Guidelines Institute (FGI) need to be considered? While ETS-Lindgren does not directly get involved in these associations or accreditations, we offer tools to help implement the recommended or required compliance solutions.

Patient and staff safety is one of the primary concerns when designing an MRI imaging suite. Optimization of patient and staff ingress and egress through these controlled areas requires additional unique design considerations that may not be contemplated for other areas of the healthcare facility.

- a. **Ferromagnetic detection ensures the safe operation of the MRI suite.** Patients and/or staff can be scanned before entering the shielded environment to detect the presence of ferrous material (both visible and non-visible, such as people with implants). The presence of unaccounted for ferrous material may adversely impact the safety of patients and staff by potentially becoming projectiles in the presence of the scanner's large magnetic field. Additionally, non-magnetic metals on patients need to be accounted for to reduce the potential for RF induced burns and imaging artifacts created by their interaction with the RF energies transmitted during the imaging process. A variety of products from metal screeners, to entryway systems or handheld devices, can be implemented as part of the design. ETS-Lindgren offers all technologies with the SuiteSentry™ line of ferromagnetic detectors, including doorway mounted and hand-held models.
- b. **Procedure or barrier to entry also ensures the safe operation of the MRI suite.** While detection technology offers valuable information that users require to make proper safety decisions, the technology cannot replace the requirement for the proper institutional perspective on MR safety. A culture of safety is a collective mindset shared by every individual that ensures safety is a consideration in every decision, that tools are utilized properly with a conscious awareness of their limitations and safety performance metrics are reviewed to ensure continuous improvement measures are instituted. Implementing a flow diagram, process checklist, effective warning signage, and control systems all provide awareness for patients and staff safety. Tools such as the TechGate® MRI access control technology provides automated access control measures that are in place 24 hours a day, 7 days a week. Doorway interlocks or card readers may be used to secure the entryway into the MRI suite and limit access to trained personnel only.
- c. **Air quality must also be considered when planning your suite.** ETS-Lindgren's Oxygen Monitoring System (OMS) is a sample draw monitoring system that alerts and alarms when oxygen levels fall below safe limits for human health. Under normal conditions, the air we breathe contains an oxygen concentration of 20.9%. Anything less than 19.5% is considered a health hazard. The OMS system monitors the air in MRI rooms, labs, freezers, confined spaces, and other locations where inert gases may displace the oxygen and create a danger for patients and staff. The OMS can be used indoors or outdoors.

These barriers are tied closely to the safety measures mentioned previously, to ensure optimal functionality of the imaging equipment combined with patient and personnel safety. A detailed conversation with the end users at the MRI facility or planner is generally required to fully understand the safety policies and procedures that govern the intended use of the area by facility management. Incorporation of proper safety procedures, tools and an institutional culture lead to an overall safety environment with which employees want to be associated.





8. Appreciate the Importance of Maintenance to Protect your RF Shield and Magnet Investment.

A key to the continued successful use of an MRI suite is the assurance that the equipment and supporting technology are always working at top performance levels to ensure the optimal images from your magnet. The RF shield should not be perceived as a building component but a piece of support equipment just like a chiller or the MRI equipment itself. If the shield does not work – the magnet does not work. This requires preventative maintenance (PM) that is scheduled and performed on a regular basis. Equipment vendors offer PM and service contracts, which provide for a predetermined number of annual visits and varying service response times.

As with any MRI suite, periodic maintenance is required to check and fill helium levels, examine cabling for wear and damage, review image quality through internal diagnostic testing and checking coils and patient tables to ensure they are functioning as expected and are in good condition. The RF shielding system that is integral to obtaining the highest quality images is another important component requiring maintenance.

The RF doors used in the shielding of an MRI suite require frequent cleaning which facility staff can perform. The operational maintenance of these doors should be performed by certified RF shielding technicians to ensure continued RF integrity. All RF contacts, mechanisms and control systems should be reviewed for wear and tear with parts replaced as needed. A recertification of the entire RF shield should be performed annually through RF testing by a qualified test agency.

It is important that the equipment and shielding suppliers are under a service contract that provides for emergency response to resolve issues that may otherwise prevent a scan procedure from taking place as scheduled.

MRI represents a significant investment. Making sure yours performs with minimal downtime and continues to function longer is critical to patient care and the bottom line. We understand what's at stake, so we continue to invest in our team of dedicated MRI shield service technicians. With an average tenure of 20 years, these professionals are experts when it comes to maintenance, repair and testing. Our clients love us because we're not only able to respond quickly, we're often able to diagnose the problem and resolve the issue – often on the same call.

9. HVAC Venting.

An often overlooked, but important feature of any RF shielded enclosure, is the air transfer waveguides. As with any facility, efficient air transfer into the MRI Suite results in cleaner air, enhanced patient comfort, and energy savings. To prevent the adverse effects and maintenance required to address clogged return air waveguides, select open cell waveguides as opposed to the honeycomb style waveguides typically used with RF shielded enclosures. For the MRI Suite application, open cell waveguides ensure efficient airflow and low maintenance.

10. Warranty and Customer References.

Ask your RF shielded MRI suite provider to provide their warranty terms for your evaluation. Then, like any warranty, make sure the company is financially sound enough to support future warranty services. An extended warranty has no value if the company offering the warranty cannot support it or is out of business when the warranty services are required. Last but not least, do your homework and ask all your potential suppliers to provide customer references from recent, and not so recent, projects. Then, follow up on the references and ask the questions that may concern you when evaluating a supplier's proposal. Validate that the supplier met the requirements of a past contract and that the customer would recommend the supplier for your project.



Need additional assistance? ETS-Lindgren can help! Contact your local ETS-Lindgren representative, phone us at +1.512.531.6400, or visit our website at www.ets-lindgren.com.

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