White paper

For users in India, conventional obstacles to MRI installation are no longer a problem – thanks to MAGNETOM Free.Star

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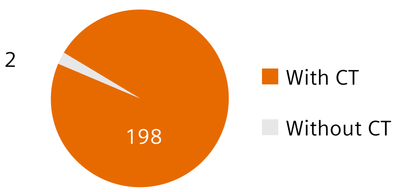
Introduction

Hospitals and diagnostic imaging centers face numerous challenges when it comes to the installation of imaging equipment – MRI machines, in particular, require very specific and thorough consideration and adaptation of infrastructure for a robust operation. A market research study of 200 diagnostic imaging centers in India highlighted significant barriers to MRI services. While 99% of survey participants are able to offer CT imaging, only 64% offer MRI services today. Out of those, 31% cited challenges related to installation requirements, such as the need for a quench pipe, and 30% reported lack of appropriate space in which to install an MRI system as being among their top reasons for not adopting MRI.[1]

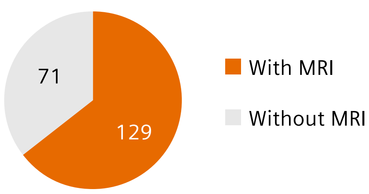
Count of centres with and without CT

N = 200



Count of centres with and without MRI

N = 200



Top reasons for not adopting MRI

31% Challenges to installation requirements (e.g., quench pipes, ...)

30% Lack of appropriate space to install MR imaging systems

"We are operating 40 MRI scanners all over the country. Despite our experience, adding another MRI system is associated with multiple challenges for us – finding appropriate space, getting power supply for both the MRI system and air conditioning, installing a quench pipe and filling the system with liquid helium are the biggest challenges we see."

Dr. Prasanna Vignesh, Director at Aarthi-Scans, India

In this white paper we introduce an MRI system that overcomes these challenges. MAGNETOM Free.Star takes a disruptively simple approach to MRI, leveraging the full power of digital innovation to create a new breed of MRI system that boasts a sustainable business model and access to high-value care.
MAGNETOM Free.Star addresses head-on the issues of cost and complexity, simply because it is designed to fit into existing infrastructure.

Challenges and Solutions – how MAGNETOM Free.Star will change the MRI game in India

Helium and its infrastructure requirements

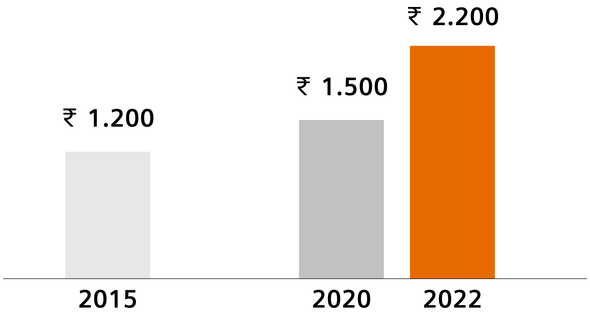
Superconducting coils, which conduct electrical current without resistance, are used to generate the powerful magnetic field required by modern MRI systems. Extreme cooling is essential for the operation of these magnetic coils, and liquid helium is the only medium cold enough to rid metals of their electrical resistance, thus enabling them to generate powerful and stable magnetic fields.

Depending on the main magnetic field strength, conventional MRI scanners can require up to 1,500 litres of liquid helium for cooling. This reliance on huge quantities of helium is one of the biggest challenges facing most MRI systems.

Why does the helium requirement impose a challenge?
The reason is twofold.

First, because helium is exceedingly rare, and our planet's supply appears to be running low. About a quarter of all the helium consumed worldwide is used in MRI systems, and demand is rising – as is the cost. In 2022 the helium price reached its all-time high of ₹ 2,200 per litre.[1] This translates into costs of ₹ 33,00,000 for helium refill after a magnet quench.[2]

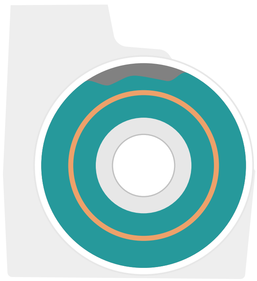
Helium price history in India (₹/litre)



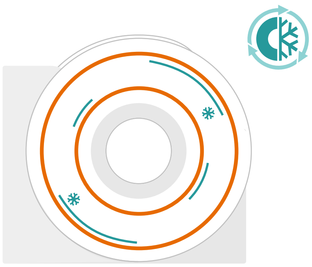
Second, conventional, helium-filled MRI scanners require quench pipes, which allow helium to safely escape from the building directly into the atmosphere in the event of an unexpected temperature increase. Depending on the location of the MRI scanner in the building, installing a quench pipe of this kind generally calls for costly construction work.

The installation of a quench pipe typically costs ₹ 2,00,000.00.[2] Longer quench pipes which cross multiple walls are even more costly. This is one reason why MRI systems are frequently installed in spaces next to outer walls. In rented facilities, contracts with the landlord may not allow for the installation of a quench pipe, hence posing an obstacle that cannot be overcome for imaging providers without moving the entire practice.

Simply put, the answer is to reduce the amount of helium needed for cooling. The innovative DryCool technology used in MAGNETOM Free.Star accomplishes just that, in what arguably amounts to a leap in MRI technology. In order to keep the need for liquid helium as low as possible, closed-circuit systems minimize the mass of components that require powerful cooling. At the same time, perfectly coordinated magnet components mean that the system generates less thermal energy overall. Finally, highly optimized thermal coupling allows exceptionally efficient conduction of any remaining heat in the system. These and other measures reduce the amount of liquid helium required to 0.7 litres only, and easily enable sealing of the liquid helium inside the system for its entire lifetime.



Conventional MRI
> 1,500 l helium



DryCool technology
0.7 l helium

Sealing liquid helium inside the system eliminates the need for a quench pipe. This results in cost and time savings on the installation of the MRI system. The absence of a quench pipe gives healthcare providers greater flexibility because these MRI systems can be installed anywhere within the imaging facilities. And, of course, rental contracts that prohibit the installation of quench pipes are no longer a concern.

The good news does not stop there. The built-in automation in the MAGNETOM Free.Star allows it to react to unstable power and temperature conditions, ensuring maximum service time even in geographically challenging regions.

Power line supply

MRI systems consume a large amount of power. When in use, some MRI machines have peak power demands as high as 200 kVA. And unlike X-ray and CT scanners, which do not consume a lot of power when not in use, resting MRI systems still need to consume a significant amount of power in order to keep the helium and the magnet cool.

As a result, the decision to expand into MRI frquently involves the need for a high-tension line beyond the Indian standard of 90 kVA. This not only adds another complex element to the MRI project, it also represents a major, time-consuming activity in the project plan. The time required to install a high-tension line can exceed up to 6 months in India today. On top of the time, the installation of a high-tension line is associated with significant costs, typically in the range of ₹ 25,000,000.[2]

The maximum line power supply for MAGNETOM Free.Star is just 44 kVA, well within the Indian standard of 90 kVA. Hence, a low-tension line suffices to safely operate MAGNETOM Free.Star in existing centers. And organizations setting up a new center need only plan for a ₹ 2,000,000 – a fraction of what a high-tension line costs, resulting in a savings of ₹ 23,000,000.[2]

Air conditioning tonnage

Air conditioning is another costly infrastructure element, but one that is absolutely critical for operating MRI scanners. Conventional MRI systems require air conditioning tonnage of 10 tons on average. In addition, to safely operate these systems, healthcare providers must plan for a backup system. This typically involves an investment of ₹ 2,000,000 for the two air conditioning systems, plus installation costs of up to ₹ 600,000.[2]

MAGNETOM Free.Star only requires air conditioning tonnage of 3.5 tons, which means that even with a second backup AC unit, only 7 tons of air conditioning are required – approximately one third of what is required for a conventional MRI system.

A cooling capacity of 7 tons requires an investment of ₹ 700,000, with simplified installation costing approximately ₹ 210,000.[2] Thus, while cooling, investment and installation costs for a conventional scanner add up to ₹ 2,600,000, the MAGNETOM Free.Star costs only ₹ 910,000.[2]

Space and floor-load

MRI systems bring with them a number of space and floor-load requirements that need to be met before the units can even be installed, let alone operated.

For a start, at least three and usually four adjoining rooms are required. These are:

- A **Scan Room** that houses the magnet and the table.
- An **Equipment Room** that holds the cabinets of the electronic equipment that connect to the magnet.
- A **Control Room**, where the technician is located during the scan.
- A **Changing Room**, which is not absolutely required but is expected by most patients.

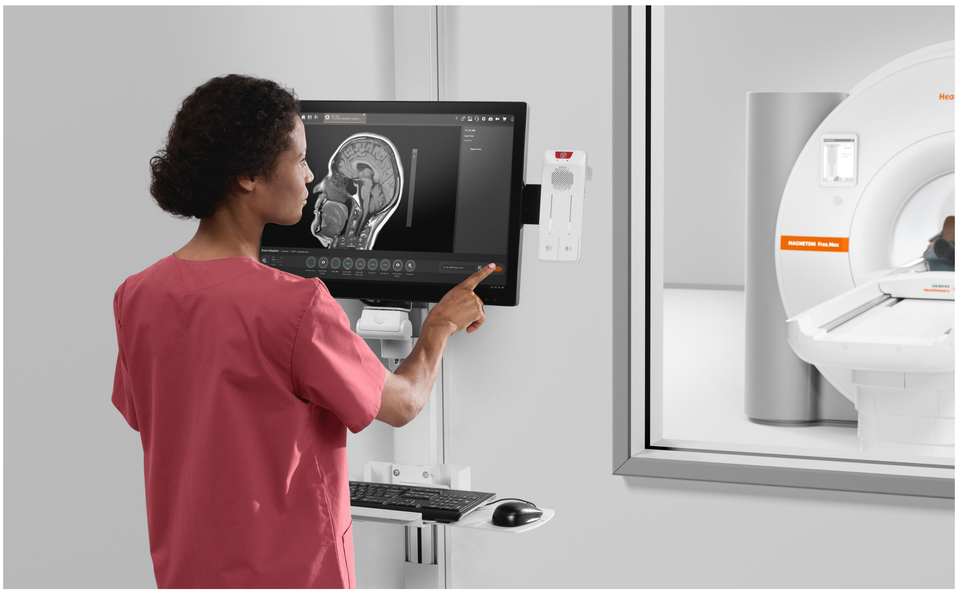
With respect to installation, the entry route of the magnet to the scan room needs to be clearly defined. Conventional MRI scanners frequently do not fit through regular doors and hallways, due to their size and weight. Hence the facade often needs to be opened up in order to allow the magnet into the building. In some cases, the floors even need to be supported from below while the system is being installed. Once the MRI system is in the exam room, the facade of the building can be closed again and the HF shielding cabin can be closed, and final construction work can be finished.

Over and above the installation challenges, the requirements of the scan room are particularly challenging for some healthcare providers. Conventional MRIs need a scanner room that is between 270 and 350 square feet, with a clear height of 7 to 9 feet. And the room needs to be able to bear the heavy weight of the MRI system. Conventional superconducting MRI systems weigh between 5 and 7 tons, and the weight of permanent magnets is often more than double that. Because of this, MRI systems can often only be installed in basements or on ground floors, and even then they may require extra suspension to carry the weight of these systems. Increasing the floor-load capacity of an existing building can be costly.

The complexity of this installation process and the costs associated with it may be prohibitive for healthcare providers. Certainly, between cost and the need to manage weight, space and external factors, it can be very difficult for healthcare providers to find ideal sites for MRIs – in particular in rented spaces.

The MAGNETOM Free.Star is our most compact MRI system, and is significantly more compact and lighter than conventional MRI systems. The MAGNETOM Free.Star weighs only 3.1 tons, making it possible to install this system in a wide variety of buildings. In addition, its compact size makes it installable in scanner rooms that are only 240 square feet, and it fits in the smallest RF cabins. Furthermore, the system is less than 2 metres high, making it much easier to transfer it to its destination in the hospital through normal doors and down regular supply paths.

As noted above, operating an MRI scanner requires spaces beyond the exam room. In some facilities, healthcare providers struggle to find speace for a control room next to the MRI scanner. In order to address this challenge, MAGNETOM Free.Star is designed so it can be operated without a dedicated control room, but instead from a kiosk-like console that can be installed outside the scanner room. This option provides additional flexibilty for healthcare providers in their planning process.



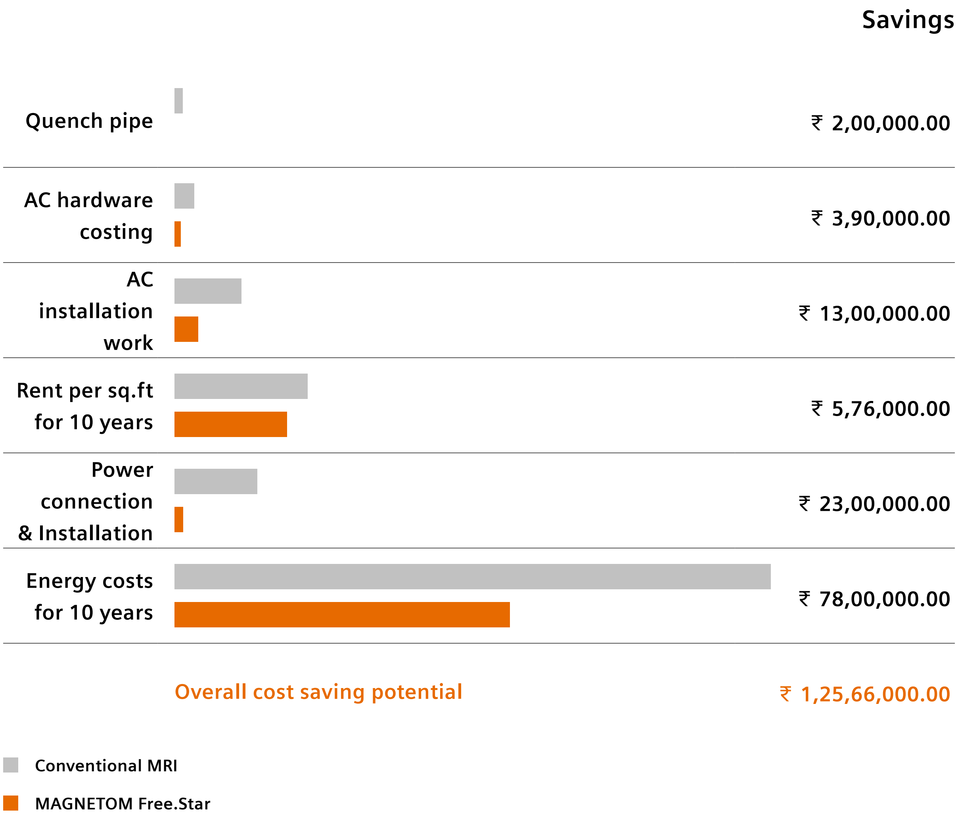
Conclusion

Because of their undeniable diagnostic value, the ability to offer MRI services is critical for healthcare providers. The impediments to adapting MRI into a radiology environment have reduced access to early and effective diagnostics for patients and this remains a global challenge. With the engineering innovations built into MAGNETOM Free.Star, we are able to overcome a significant range of challenges to MRI installation and operation, which enables us to take MRIs into new places and provide access to life-saving diagnostic equipment to more patients.

MRI system cost and installation challenges should be considered the problems of yesterday. With a lightweight MRI system that has a compact footprint and is equipped with the sealed-for-life DryCool technology, enabling MRI operation with a mere 0.7 l of helium, it is now less a question of whether to purchase this MRI than when to do so.

MRI systems are expensive to buy and difficult to operate. Organizations in a position to deal with these challenges should not have their plans disrupted by the simple fact that they cannot get their new MRI installed. Research in India shows, however, that most providers who want but are unable to get into the MRI business overwhelmingly blame challenges related to installation.

Infrastructure and installation costs for a conventional MRI and MAGNETOM Free.Star[2]



As this white paper has shown, there is a new MRI system that clears many of the obstacles to installation with which providers in India have previously had to contend. It requires dramatically less helium than conventional MRI systems, making it cheaper, easier to install.

The MAGNETOM Free.Star is ushering in a new era in MRI technology.

References

[1] *Data on file*

[2] *Calculation based on internal records and estimates.*

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Published by Siemens Healthineers AG · 0424 · online ·